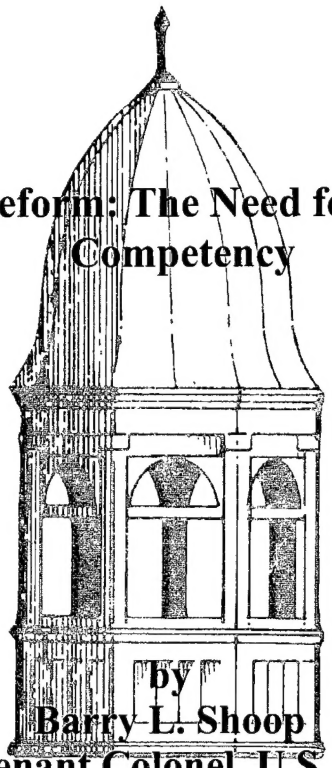
The Center for Naval Warfare Studies

Officer Education Reform: The Need for Increased Technical Competency



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Officer Education Reform: The Need for Increased Technical Competency.

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This paper was completed as an independent research project in the Advanced Research Program, Center for Naval Warfare Studies, Naval War College. It is submitted to the faculty of the Naval War College in partial fulfillment of the academic requirements for the degree of Master of Arts in National Security and Strategic Studies. As an academic study completed under faculty guidance, the contents of this paper reflect the author's own views and conclusions, based on independent research and analysis. They do not necessarily reflect current official policy of any department or agency of the U.S. government.

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Executive Summary

The officer education system shapes the leadership of the armed forces and provides the core competencies that are required to lead soldiers, sailors, airmen, and marines and the high-technology military systems they employ. In order for officers to effectively employ technologically advanced weapon systems, they require a basic understanding of the science that enables these systems.

The new security environment facing the U. S. Armed Forces that spans the full-spectrum of military conflict together with the military's relentless quest for high technology solutions to challenges in modern warfare requires new leader skills. Among these are multidimensional cognitive skills, new technical-tactical skills, and an increased awareness of the science that enables advanced technology weapon systems and shapes the modern battlefield. Today there exists a new relationship between the officer corps and technology. As a result, the current officer education system needs to be reformed to incorporate more of the underlying science that enables advanced technological systems and shapes the modern military landscape. This research begins with a historical review of military innovation and the relationship to officer education and progresses to include a survey of applicable teaching and learning theories, methodologies, and taxonomies. Five broad categories of technical officer competencies were identified and include information technology and communication systems, the science associated with sensor systems, fundamentals of chemistry, biotechnology, and nuclear energy and radiation, military physics and engineering, and quantitative and analytic skills. The need for officer education reform was confirmed through an analysis of each of the Service's PME systems to determine the extent of science and technology coverage in the present curricula. This analysis also included Joint Staff policy relating to technical learning objectives and the proportion of officers attending each of the PME institutions. Finally, a prototype educational framework was developed that increases officer technical competency by reforming the existing officer PME system through the introduction of technical short-courses.

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Chapter 1. Background and Motivation

> The nation that will insist on drawing a broad line of demarcation between its fighting man and the thinking man is liable to have its fighting done by fools and its thinking done by cowards.
>
> — Sir William Francis Butler

1.1 Introduction.

The idea that the application of the military instrument of power in the conduct of war rested in a body of knowledge that could be studied and mastered by those in the profession of arms is a relatively recent concept. During the 16th Century, the officers who led armies into battle did not receive any special training or education in the conduct of war but instead received their appointments as a result of aristocracy, heredity, or wealth. Around the turn of the 17th Century, advances in technology first changed the requirement for education of specialists. Navigation, artillery, fortifications, and engineering[1] were all subjects first studied by officers to be more effective leaders in the profession of arms.

It can be argued that officer education is the cornerstone of the profession of arms. Carl von Clausewitz, noted 19th Century Prussian military theorist, suggested that "if you want to overcome your enemy you must match your effort against his power of resistance, which can be expressed as the product of two inseparable factors, viz. *the total means at his disposal* and *the strength of his will*."[2] The tension between adversaries and competition in achieving superior means leads to what Clausewitz identified as the *third case of interaction* and *the third extreme*. It is the responsibility of the military to continually develop and adapt new and improved methods of warfare as a way of achieving superior means to conduct war.

However, to be effective the process of adapting and adopting requires leaders who are imaginative and innovative. Education enables informed and creative leadership.

1.2 The Need for Educational Reform.

> For most men, the matter of learning is one of personal preference. But for [military] officers, the obligation to learn, to grow in their profession, is clearly a public duty.
>
> — General Omar N. Bradley

The current officer professional military education (PME) system in each of the Services can be broadly characterized as a product of the Cold War. Intense specialization and a well-defined enemy produced an officer PME system more focused on training than on education, a condition that persists today. Instead of educating officers for the complex and uncertain strategic environment of the 21st Century and embracing the technological transformations resulting from the advent of the microchip and the Internet, it is focused on training officers predominately as generalists in tactics, doctrine and strategy. Arguably, a different officer PME system and a different relationship between the officer corps and technology is required in an era where technology enables thinking machines than was required in the industrial age, whose technology produced tanks, artillery, airplanes, and submarines.

There are a number of convincing arguments for the need to transform the current officer PME system to increase the educational content in the curricula and include more coverage of technical subjects. The most compelling stems from a disconnect between the sophistication of modern military systems and the understanding of these systems by those who lead organizations that employ these systems. While advanced technological systems continue to be infused throughout each of the Services, no corresponding change in the

officer PME system has accompanied these modernizations to include coverage of the underlying science and technology of these systems.

Officer education has long been a focus of both individuals and study groups. The first prize papers awarded for contributions to the *Proceedings of the U.S. Naval Institute* in 1879 were on the subject of officer education. The Prize Essayist was awarded to Allan D. Brown[3] for the paper "Naval Education" while First Honorable Mention went to C. F. Goodrich[4] and Second Honorable Mention went to Alfred Thayer Mahan[5], both of whom also wrote articles entitled "Naval Education." In 1957, John Masland and Laurence Radway published *Soldiers and Scholars*,[6] as an analysis of military education and its relationship to national policy. More recently in 1990, Martin van Crevald wrote *The Training of Officers*[7] that compared and contrasted the U.S. approach to officer training with those of other countries. In 1996, an Army Science Board (ASB) Study titled *The Science and Engineering Requirements for Military Officers and Civilian Personnel in the High Tech Army of Today and Tomorrow*[8] specifically focused on the need for increased officer technical competency. This study concluded that while "the Army's reliance on modern weapon systems and technology has been growing, its cadre of technology-literate line officers and science, math, and engineering (SM&E)-educated officers has been reduced." In 1997, a Center for Strategic and International Studies Report entitled *Professional Military Education: An Asset for Peace and Progress*[9], included numerous references to the need for increased technical competency in all of the Services, recommending that the Services "establish technological core competencies that should be taught at each PME level[10]." In 2000, Eliot Cohen criticized the current state of the military's educational institutions saying "[T]he U.S. military's educational institutions are relics of the Cold War, devoted primarily to producing

well-rounded practitioners, experts in tactics and familiar with the broader aspects of strategy. ... Service on their military faculties usually indicates a career coming to an end, and officers who acquire doctorates or write books do so as a hobby – often at the expense of their careers rather than to their benefit."[11] Cohen further suggests that "[T]oday the overburdened American military emphasizes doing, not thinking. Yet never was thinking more necessary."[12] Also in 2000, advocating a revolution in military affairs (RMA) based on information technology, Admiral William Owens, former Vice Chairman of the Joint Chiefs of Staff, called for the need for a transformed military education system.[13] Most recently, Cohen, in an analysis of current defense planning stated, "[T]o meet the range of known and unknown challenges the United States faces, the military will need to cultivate two functions that it has largely neglected during the last decade and before: mobilization and professional education."[14] This body of literature continues to build and articulates a recurring message: officer professional education needs to be reformed with a focus on increased technical competency.

In the current and future military environment there exists a changed relationship between officers and technology. Firepower and maneuver previously defined the realm of officer competencies. The American way of war and the relationship between systems engaged in warfare on the modern battlefield has fundamentally changed as a result of modern technology. No longer will artillery units be defined as direct or general support and separate from maneuver units. Instead, distributed fires directly controlled by individuals and maneuver units linked through ubiquitous communications networks to distributed multifunctional platforms that can provide both direct and indirect fire will provide near instantaneous kinetic effects. No longer will a commander request reconnaissance or

intelligence products. Instead these products will be distributed in near-real time through the same ubiquitous communications network providing the commander with a near-instantaneous picture of the battlespace. The realm of officer competencies in this new military environment is now defined by information and knowledge.

In the postindustrial age, information is abundant and knowledge is critical. Knowledge, however, is an individual characteristic. The shift to a knowledge-based society and an information age military establishment positions the educated person in the center.[15] Knowledge of modern technology, economics, history, and strategy are indispensable to senior officers and is essential in the development of a coherent view of modern warfare. Currently, however, modern warfare in the traditional sense of an established body of knowledge remains ill defined. This is partially a consequence of the fast pace of innovation and rapid integration of modern technology into the armed forces. In this fast paced, dynamic environment of technological innovation, officer technical competency is at a premium. The education that enables this competency must begin early in an officer's career and be reinforced often throughout his or her career to ensure these intellectual skills remain current and do not atrophy.

1.3 The Historical Landscape of Education and the Profession of Arms.

Officer education and the professionalization of the officer corps can be traced to the mid 19th Century. Prior the 16th Century, those who commanded armies were nobility. During this period, no formal training or education was required of those who led armies into battle. Before this time, there was little distinction between the strategic level of war and the tactical

level of war. Armies operated in single massive formations employing weapons with limited range and accuracy. Officers commanded these large formations by leading from the front of the formation.

The period between 1850 and 1900 witnessed significant social and political change as well as change in the technology and doctrine employed to wage war. Napoleon's *levee-en-masse* radically changed the nature of warfare by significantly increasing the size of armies used in the conduct of war and marked the beginning of a professional officer corps. Railroads were first employed for large-scale troop movement and supply by the French in the late1850s[16] and later their importance in military mobilization and deployment was defined by the Prussians under Helmut von Moltke in the war against Austria in 1866 and against France in 1870. The telegraph allowed rapid communications with armies dispersed over large distances. During this period rifled barrels changed the range and effectiveness of both individual weapons and artillery. Doctrine also changed to enable tactical and operational maneuver and to take advantage of dispersed units and the increased range and accuracy of new weapons. All of these changes in warfare taken together significantly increased the complexity of preparing for and conducting war. Prussia was the first to recognize the importance and complexity of these changes and the need for a professional staff to plan and execute military operations. It was the training and subsequent effectiveness of the officers of the Prussian General Staff that enabled the successful transformation of the Prussian Army that led to the subsequent military successes over Austria and France in 1866 and 1870, respectively.

The need for a professional officer corps and a professional planning staff grew from the need to control dispersed armies operating over an extended battlefield at increased speed

of maneuver with weapons of increased range and effectiveness. During this period, there was also little opportunity for direct control of these dispersed units and therefore a highly trained staff was required to ensure plans were executed within the commander's intent. It could be argued that the current transformations within the U.S. Department of Defense (DoD) require a similar change to the officer education system. Network centric warfare, a concept being embraced by each of the Services in various forms, is envisioned to enable smaller, more lethal units to be dispersed over greater distances operating at increased speed of maneuver. The expanded battlespace at all echelons and the near instantaneous visualization of both friendly and enemy forces significantly increases the span of control of individual commanders and the complexity of operations. Furthermore, other technological innovations intended to make the operation of military systems more efficient and thereby reduce the number of soldiers required to operate these systems also increases the breadth of knowledge required of officers employing these systems.

At the turn of the 19th Century, the movement in the United States to develop the War Colleges was based on a perceived need for officers to study policy and strategy. During this period and afterward, technical education became increasingly specialized, both in subject and clientele. The common thinking at the time was that all officers needed to understand strategy and policy but the technical realm was relegated to and inhabited by sub-specialists. This approach shapes officer personnel management and PME to this day. However, this paradigm requires change. Information, communication networks, and sensing systems permeate all warfare areas to the extent that technical competency is now required of all officers. Consequently, a corresponding change in the officer PME system is required that includes the science and technology that shapes modern warfare.

The recent focus on transformation in the U.S. Armed Forces is a deliberate attempt to leverage the technological advances provided by innovations in the semiconductor and telecommunications industries. Many envision these technological advances providing an RMA. While an RMA does not necessarily require technological innovation, the current transformation is heavily invested in technology to lighten the force while increasing the lethality and survivability necessary for full-spectrum dominance. The general categories of technological innovations that are being leveraged include computer, communication, and network technologies for the network-centric component, advanced and distributed sensors to provide improved multi-spectral sensing capabilities, composite materials that reduce the overall weight while maintaining or improving the capabilities of the protective armor, electric and hybrid power systems for propulsion and weapons, and many others.

The technologies that support the current transformation come from many diverse disciplines and provide a broad range of improved capabilities in the areas of lethality, mobility, survivability, situational awareness, and battlefield visualization. To be effective in this new and increasingly complex environment, leaders now require a better understanding of the underlying concepts of the technologies that support the latest transformation.

1.4 Cultural Adaptation and the Role of Education in the Armed Forces.

> If you don't like change, you're going to like irrelevance even less.
> — General Eric K. Shinseki
> Chief of Staff of the Army

Throughout history, the pursuit of knowledge and understanding, discovery and innovation, new technology, change, religion, and superstition have all been inextricably entangled.

Explorers, pioneers, inventors, and scientists during the middle ages and well into the 19th Century were often imprisoned or put to death for association with perceived dark necromantic forces. Roger Bacon, the most celebrated European scientist of the Middle Ages, studied light and the rainbow and the process for making gunpowder and was accused of black magic and imprisoned by Pope Clement IV.[17] Ignorance breeds fear and individuals who lack understanding fear change. While modern society no longer imprisons or executes those involved in discovery, there remains great resistance to many modern scientific and technological changes.

Change can take the form of organizational, operational, or individual change, or result from the integration of new technology. Change can be a difficult obstacle to overcome and reducing resistance to change can often be more difficult than the change itself. Although change can be implemented through purely dictatorial approaches, acceptance of change must be accompanied by a corresponding change in cultural behavior to be effective. Scholars of innovation and change within large organizations identify certain personal attributes or characteristics that make individuals successful in implementing change. Among these attributes are a higher degree of intelligence, more favorable attitudes toward change, more individual education, and a more favorable attitude toward risk taking.[18]

Throughout history, technological change within the military unaccompanied by a corresponding cultural change has resulted in failure. The following examples of military innovation that lacked a corresponding cultural adaptation resulted in either costly consequences or failure.

1.4.1 Naval Airpower in the Sino-Japanese War.

One example of the consequences of failing to integrate military innovation with cultural change began during the summer of 1937 with the outbreak of the Sino-Japanese War. During this period, airpower was in its infancy. In August of 1937, the Japanese Navy's medium-bomber forces pressed attacks against Chinese air bases in the Yangtze River Valley.[19] This early application of long-range bombing proved disastrous for the Japanese bombers, being destroyed in alarming numbers by the faster and more maneuverable Chinese fighter aircraft. These were some of the first examples of fighter interception of bombing raids.[20] At the time, bombers were employed without fighter escorts because the Navy did not believe they needed escorts and because long-range fighter escorts were not available anyway. Land-based, medium-range bombers of the period were the Mitsubishi G3M2 Model 22 Type 96[21] attack bomber and carrier-based attack bombers were the Mitsubishi B2M1 Type 89[22]. While the Mitsubishi G3M2 contained some on-board armament, Japanese bomber formations lacked the cohesion to take advantage of this armament and thereby provide more collective defensive firepower. As the war progressed, new bombers were developed with increased armament for self-protection and new fighters became available, first the A5M carrier fighter then later the famed Zero fighter. While the A5M carrier fighter had substantially improved performance and combat capability, even using drop fuel tanks and operating from forward bases, they did not have the range to provide protection to the bomber fleets operating deep into the Chinese mainland.[23] It was not until the development of the A6M Zero in late 1940 that dedicated fighter escorts became a reality.

Because the bombers, even with additional armament, remained vulnerable to enemy fighter attack, fighter escorts were absolutely necessary to protect the slower bombers from

the Chinese fighter aircraft. However, one of the problems in the early development of fighter tactics was the Japanese tradition of personal combat, embodied in the persona of the Samurai, which dated back to the Middle Ages. Consequently, Japanese fighter escort pilots preferred individual dogfighting to the mundane duty of bomber escort, which subsequently left the bombers yet again unprotected and vulnerable. It was not until the end of this war that Japanese fighter pilots came to understand the importance of escort duty. Unfortunately, this cultural adaptation came at a high cost. Between 1937 and 1941, the Japanese Navy lost 828 men and 1169 aircraft with the preponderance of these losses coming from the bomber force and the greatest losses suffered in 1937.[24]

While the Japanese possessed educational institutions during this period, including a naval war college, the military focused nearly exclusively on doctrine and strategy of achieving a decisive victory.[25] As a result, the Japanese leadership, including the war college faculty, failed to think broadly and creatively about issues associated with the new technology, attrition warfare, and logistics. While not implying that education alone could have reduced the cost of cultural adaptation in this instance, education does develop higher-level cognitive skills that enable critical thinking and dealing with uncertainty. Education is also the best method to affect changes in knowledge, skill, and attitudes and consequently cultural tradition and biases.

1.4.2 Battlefield Digitization and Visualization in the Army Warfighting Experiment. The Army has embarked on a series of warfighting exercises with the intent of testing and validating the integration of modern technology with new tactics and doctrine. Former Chief of Staff of the Army (CSA), General Gordon Sullivan, institutionalized a concept-based

orientation toward experimentation with the first in a series of Army experiments called Louisiana Maneuvers. These experiments eventually were formalized in the Army Experimentation Campaign Plan (AECP)[26]. Since 1994, the Army has instituted a series of new exercises called the Advanced Warfighting Experiments (AWE) specifically to develop digitization and visualization concepts. In early 1996, experimental equipment was fielded to the 1st Brigade, 4th Infantry Division (Mechanized) at Fort Hood, Texas. This unit became the core of a brigade combat team designated as the Experimental Force (EXFOR).[27] During a two week AWE in March of 1997 at the National Training Center at Fort Irwin, California, Task Force XXI (TF XXI) from the EXFOR experimented with 72 different initiatives including both prototype equipment and operational concepts.[28] This AWE was followed in November 1997 by a division-level simulation AWE held at Fort Hood.[29]

During the AWE at Fort Irwin, the TF XXI command center resembled a high-technology control center similar to those seen during NASA shuttle launches, with large flat-panel displays to portray the common operating picture. Figure 1.1 shows a screen-capture of the display during the early portion of this particular exercise. Friendly elements are depicted in blue (concentration of units to the right of PL Buford), enemy forces in red (concentration of units to left of PL Meade).

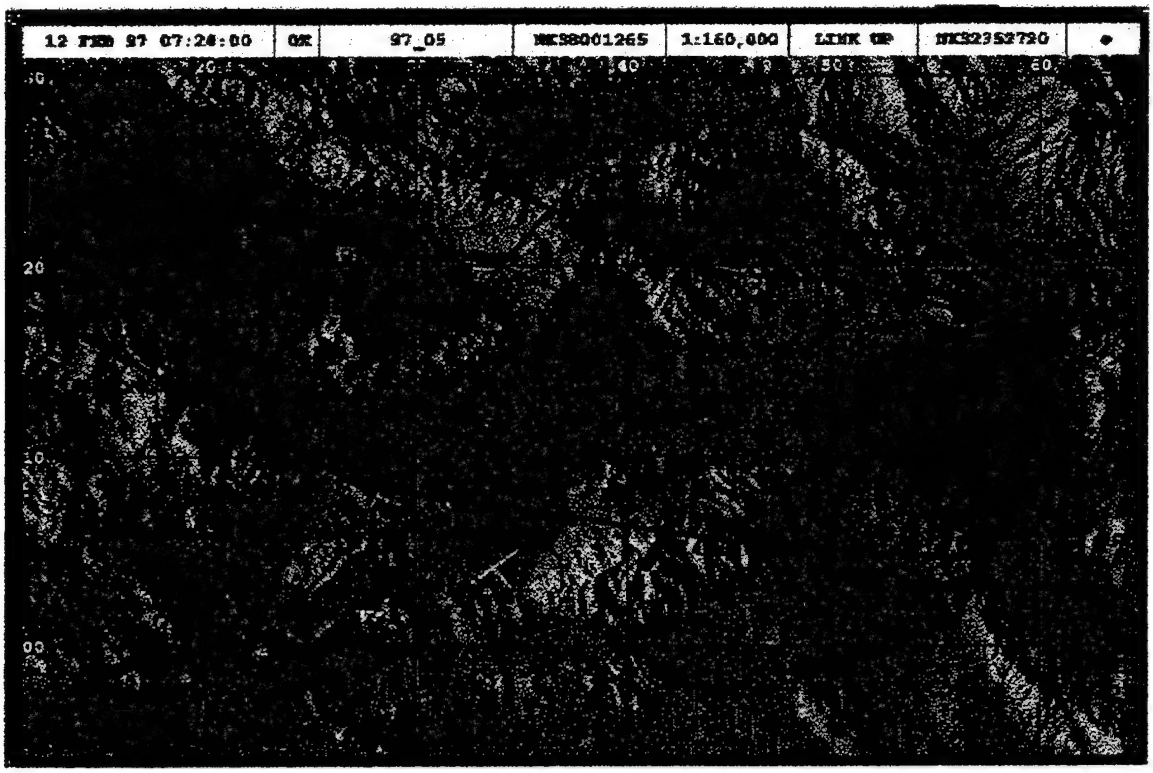

Figure 1.1. Common operating picture of AWE on February 12, 1997.

This graphical depiction of forces shows enemy forces in a valley, confined between two parallel mountainous regions. Instead of maneuvering blue forces to flank or encircle the enemy forces, the TF Commander instead ordered the deployment of scouts to substantiate the information. By the time the scouts confirmed the enemy situation, the initiative and consequently the advantage had been lost.

This single episodic event during the AWE first and foremost demonstrated the capabilities of advanced sensors and battlefield visualization. It also demonstrated a lack of cultural acceptance of this new approach to battlefield command and control. The actions of the TF commander are certainly not unique and are representative of what appears to be a more recurrent human reaction to the use of new methods of warfare during periods of intense stress.

A similar reaction to the use of improved weapons and new methods of warfare in a decisive battle can be found in two other seemingly unrelated military battles in history: the Battle of Gettysburg and the Battle of Midway. Robert Rubel drew historical parallels between the actions of General Robert E. Lee, commander of the Army of Northern Virginia during the Battle of Gettysburg and Admiral Isoroku Yamamoto, commander of the Imperial Japanese Navy Combined fleet during the Battle of Midway.[30] A particularly applicable portion of this analysis deals with old and new forms of warfare. "Despite prior battlefield successes that had taken advantage of improved weapons at their disposal, in the battles of Gettysburg and Midway both commanders reverted to tactics appropriate to weapons of the previous generation."[31] Prior to Gettysburg, Lee had enjoyed success employing the tactical defense and modern rifled muskets. These modern weapons provided improved accuracy and extended range over their smooth-bored predecessors and effectively made traditional infantry charges excessively costly and therefore impractical. However, at Gettysburg, it was Lee that ordered Picket's charge across open terrain against prepared defensive positions. Similarly, Yamamoto was the author of carrier warfare in Japan and the architect of the attack on Pearl Harbor. Yet at Midway, Yamamoto discarded this modern approach to warfare and instead reverted to employing battleships as the centerpiece of his plan.

These historical examples demonstrate the tremendous difficulty in achieving cultural adaptation. Although each of these commanders was familiar with the new technology and methods of warfare of their period, they had not fully internalized the cultural adaptation necessary to employ these new approaches with confidence in new and uncertain situations. Instead, they reverted to familiar, more traditional approaches to warfare, which they knew had been successful in the past. Education provides a means of changing individual norms,

attitudes, and perceptions and therefore achieving cultural adaptation. In all of the cases presented here, the change included an important technological component and therefore including a technical component in the education would be appropriate.

1.5 The Role of Education in a Profession.

During the 1930s, professions were characterized as a unique method of organizing and controlling work, in contrast to common formal organizations and labor unions. Two fundamental characteristics that separated professions from occupations were the application of abstract knowledge to specific situations. Other essential characteristics included organization of the occupation, extensive education of its members, service to society, and shared ethics.[32] Samuel Huntington defined a profession as a group of people, engaged in a common line of work, performing a specific service that is essential to the overall welfare of society and further identified three specific characteristics required of a profession as expertise, responsibility, and corporateness.[33] Recently in an effort to better understand modern professions, theorists have moved from the static description of professions to a dynamic conception in which professions compete within a system of professions for members, resources, and jurisdiction. In this recent characterization,[34] the factors that mark an occupation as a profession now focus on expertise, jurisdiction, and legitimacy. Within this framework, professions fundamentally create and expand expert knowledge, transfer this expert knowledge to members of the profession, and apply this expert knowledge to new situations. An important part of the responsibility of a profession is therefore to educate its members and develop future professionals with expertise. Education within a profession is

critical because professionals are expected to apply the expert knowledge of the profession in new situations. If officers are members of the Profession of Arms, it is then the responsibility of the Armed Forces to educate these members of the profession.

1.6 Scope of This Research.

The new security environment facing the U. S. Armed Forces that spans the full-spectrum of military conflict together with the military's relentless quest for high technology solutions to challenges in modern warfare requires new leader skills. Among these are multidimensional cognitive skills, new technical-tactical skills, and an increased awareness of the science that enables advanced technology weapon systems and shapes the modern battlefield. As a result, the current officer education system within the armed forces needs to be reformed to incorporate more of the underlying science that enables advanced technology systems and shapes the modern battlespace. It is not the intent of this research to diminish the importance of tactics, doctrine, strategy, and the historical study and understanding of warfare that currently characterizes the officer PME system. Nor is it the intent of this research to discard the current officer PME system in favor of a completely revised system and curricula. Rather it is the position that the technological thrust of the information age has fundamentally changed the relationship between the officer corps and technology. It is no longer possible to assign a fraction of officers to specialized technical duties while allowing the majority to focus solely on tactics, policy, and strategy. Because information has become the source of military power, and because the technology associated with the gathering, processing, and distribution information is changing rapidly, the *entire* officer corps must

develop an understanding of the science that enables the technology as well as a grasp of how to apply it. The conclusions of this research suggest that technical competency of the officer corps can be sufficiently improved through a modification of the existing PME system.

1.7 Outline of this Research Report.

The roadmap to educational reform for the officer PME system is contained in the remainder of this research report. This research first surveys applicable teaching and learning theories and taxonomies as applied to adult education in general and scientific and technical education specifically. The core technical competencies required of all officers in the 21st Century are then identified based on an analysis of the underlying science that enables current and near-term military systems. Each of the Services' PME systems is documented and analyzed to determine the level of science and technology content within each curriculum. Each Service PME system is then analyzed and compared with the other Services and the Joint Staff guidance for technical learning objectives. The rate of officer completion of each course was also analyzed in an effort to determine if the Services' PME framework could be used as a mechanism for science and technology education reform. Finally, a prototype educational framework for increasing officer technical competency within the existing officer PME system is developed.

Chapter 2. Educational Approaches and Learning Methodologies.

The current officer PME system is the product of a number of circumstances that evolved during the Cold War. Specialization and a well-defined threat produced an officer educational institution focused on training rather than education. Given the current level of uncertainty in the geopolitical environment, the lack of a clearly defined adversary, and the rapid advances in technology that has enabled numerous innovations in modern military systems, reforming the current officer PME system to increase both educational and technical content is imperative.

During the Cold War, the threat was known, exhaustively studied and the weapons, doctrine, and tactics well understood. Linguists and intelligence collection assets focused nearly exclusively on our single major peer competitor – the Soviet Union. The geography of the future battlefield was well defined and major training maneuvers exercised seemingly definitive war plans. For the Army, the focus was the Fulda Gap in Germany, the natural and historic invasion route into the heart of Europe. Year after year, units deployed there to rehearse war plans and gain familiarity with the terrain where the U.S. military confidently believed that the future ground conflict would occur. Arguably, training the officer corps made sense in this environment of relative certainty.

Today, the geopolitical environment is much more uncertain. Over the past decade, U.S. Armed Forces have responded to operations across the spectrum of military conflict from nation building and disaster relief to large-scale conventional land warfare. Some of the more prominent operations for the Army include actions in Panama, Southwest Asia, Somalia, Bosnia, Kosovo, and most recently Afghanistan. The increase in the number of

failed nation states, the increase in both state sponsored and non-state sponsored terrorism, the lack of a peer competitor, and an increasing threat from asymmetric responses to U. S. military power all contribute to growing uncertainty for those attempting to develop and maintain armed forces capable of effectively responding across the full-spectrum of conflict. This uncertain environment demands educated leaders who can successfully apply fundamental concepts of the profession of arms to new situations.

2.1 Train for Certainty, Educate for Uncertainty.

Training is defined by the Random House Dictionary as "to give the discipline or instruction designed to impart proficiency or efficiency." Training is therefore instruction that is oriented to a particular specialty and that is designed to develop a specific technical skill. Training teaches *what* to think and what the answers should be. It addresses the development and performance of specific tasks or skills. Training can be given directly to an individual or to organized units and large groups. Training improves effectiveness and efficiency.

Education is an activity undertaken or initiated by one or more agents that is designed to affect changes in knowledge, skill, and attitudes of individuals, groups, or communities. Education implies instruction or individual study for the purpose of intellectual development and the cultivation of wisdom and judgment.[35] Education can be considered a generalized abstract knowledge that can be applied across the spectrum of applications. Education deals with *how* to think about a problem.

Education is therefore critical to officer development since officers are increasingly asked to operate in an environment of uncertainty, particularly since the end of the Cold War.

Uncertainty in the strategic environment, modern technological weapons, asymmetric responses to the use of force, all lead to situations in which the armed forces may be employed in contingencies not previously anticipated. The recent employment of U.S. Army Special Operations Forces in Afghanistan who are using information technology that provides a network centric interface to Navy and Air Force strike aircraft employing precision guided weapons is an example of the dynamics and uncertainty present in the current strategic environment.

Because of the need for officers to function in a complex and uncertain military environment and the need for multidimensional cognitive skills, never before in the history of the armed forces is education more necessary than today.

2.2 Andragogy and Pedagogy.

Learning, in contrast to training and education, emphasizes the individual and is defined as the act or process by which behavioral change, knowledge, skills, and attitudes are acquired.[36] The process of learning encompasses elements of both education and training and can be visualized as a spectrum progressing from pure training to pure education. With this emphasis on the individual, educational psychologists and researchers have distinguished between two broad categories of learners, children and adults, and have developed teaching strategies for each.

Those individuals we identify as the greatest teachers in history were adult educators. Confucius and Lao Tse of China, the Hebrew prophets and Jesus in Biblical times, Aristotle, Socrates, and Plato in ancient Greece, and Cicero, Evelid and Quintillian in ancient Rome

were all teachers of adults.[37] The learning method used by these great teachers was a process of mental inquiry rather than passive reception of information. As a result, they developed techniques to engage students in the process of inquiry. The ancient Chinese and Hebrews developed what is known today as the case method in which a situation is described, often in the form of a parable, after which the student or group engages in a discussion to investigate the characteristics and possible solutions. The Greeks developed what is known as the Socratic dialog, which consists of a series of questions designed to elicit a clear and consistent expression of something implicitly known by all rational beings. The Romans used a much more confrontational approach in which group members were forced to take a position and defend that position.

Later, in the 7th Century in Europe, schools were organized for teaching children, primarily for preparing young boys for the priesthood.[38] These became known as cathedral and monastic schools whose purpose was to indoctrinate students in the beliefs, faith, and rituals of the church. From this period came assumptions about learning and strategies for teaching that became known as pedagogy. The word pedagogy, derived from the Greek root ***peda*** meaning 'child' and ***agogus*** meaning 'leader of', literally means the art and science of teaching children.[39] The pedagogical model of learning assigns full responsibility for what will be learned, how it will be learned, and if it has to be learned to the teacher. In later centuries as secular schools developed, the only existing educational model was the pedagogical model. This educational model therefore permeated the entire educational enterprise and persisted well into the 20th Century in many educational institutions, being universally applied to both children and adults.

In 1833, Alexander Knapp a German grammar school teacher first coined the term *Andragogik*[40]to describe the educational theory of the Greek philosopher Plato. It was not until 1967 that the term *andragogy* was introduced into the American educational culture as the art and science of adult learning. In comparison to pedagogy, the word andragogy is derived from a direct translation of the Greek root ***andra*** meaning 'adults' and ***agogus*** meaning 'leading'. It was Malcolm S. Knowles, who in his 1970 book, *The Modern Practice of Adult Education: Andragogy vs. Pedagogy*[41], first popularized the term in North America and organized the concepts into a comprehensive theory. Knowles devised a set of assumptions about the characteristics of adult learners that differentiated adults from children as learners.[42]

1. Self-concept: *As a person matures his self concept moves from one of being a dependent personality toward one of being a self-directed human being*
2. Experience: *As a person matures she accumulates a growing reservoir of experience that becomes an increasing resource for learning.*
3. Readiness to learn. *As a person matures his readiness to learn becomes oriented increasingly to the developmental tasks of his social roles.*
4. Orientation to learning. *As a person matures her time perspective changes from one of postponed application of knowledge to immediacy of application, and accordingly his orientation toward learning shifts from one of subject-centeredness to one of problem centeredness.*
5. Motivation to learn: *As a person matures the motivation to learn is internal.*

Early distinctions between pedagogy and andragogy implied these were distinct models. However, educational experimentation found that in some instances, the application of the andragogical model improved learning for children and youths. As a result, in the revised

edition of *The Modern Practice of Adult Education (1980)*, the subtitle was changed to "From Pedagogy to Andragogy."

The andragogical model more actively involves the student in the educational process, entrusts responsibility for learning to the student, and integrates the student's experience into the learning process.

2.3 Bloom's Taxonomy

Beginning in 1948, a group of educational psychologists headed by Benjamin Bloom undertook the task of classifying education goals and objectives. The intention was to develop a classification system for three overlapping domains: the cognitive, the affective, and the psychomotor. Work on the cognitive domain was completed in 1956 and is commonly referred to as *Bloom's Taxonomy of the Cognitive Domain* although the full title of the original work was *Taxonomy of Educational Objectives: The Classification of Educational Goals. Handbook I: Cognitive Domain*[43] with the text being coauthored by 4 other authors including M. Englehart, E. Furst, W. Hill, and D Krathwohl. The major idea underlying the taxonomy is that what educators want students to know can be arranged in a hierarchy from less to more complex. A description of the three overlapping domains and the taxonomy follows.

Cognitive learning is demonstrated by knowledge recall and the intellectual skills: comprehending information, organizing ideas, analyzing and synthesizing data, applying knowledge, choosing among alternatives in problem-solving, and evaluating ideas or actions. This domain deals with the acquisition and use of knowledge and is predominant in the

majority of courses. Bloom and his colleagues identified 6 levels within the cognitive domain, from the simple recall or recognition of facts, as the lowest level, through increasingly more complex and abstract mental levels, to the highest order, which is classified as evaluation. Research has shown that students remember more when they have learned the topic at the higher levels of the taxonomy. The six levels within the cognitive domain and the skills demonstrated in each are identified in Table 2.1.

Understanding the cognitive skills that are applied within each level of the taxonomy can be used to develop an effective educational curriculum that helps the student achieve higher-level cognitive understanding of the subject material. In constructing a specific curriculum, it is important to understand that different types of inquiry require students to use different kinds or levels of thinking. At the lowest level of the taxonomy, simple recall of facts can be developed using questions that require the student simply to restate or recall facts. However, at the higher levels of the taxonomy, the inquiry must be sufficiently complex to include questions that requires the student to compare and contrast the subject matter with other related subjects and the ability to assess specific courses of action or implications of the subject within a contextual setting.

Research over the last 40 years has confirmed the taxonomy as a hierarchy with the exception of the last two levels.[44] It remains uncertain at this time whether synthesis and evaluation should be reversed or whether synthesis and evaluation are at the same level of difficulty but use different cognitive processes. It is clear, however, that students can "know" about a topic or subject at different levels. While most teacher-made tests still test at the lower levels of the taxonomy, research has shown that students remember more when they have learned to handle the topic at the higher levels of the taxonomy.

Table 2.1. Bloom's Taxonomy of Cognitive Learning.[45]

Competence	Skills Demonstrated and Question Cues
Knowledge	– observation and recall of information – knowledge of dates, events, places – knowledge of major ideas – mastery of subject matter ***Question Cues:*** list, define, tell, describe, identify, show, label, collect, examine, tabulate, quote, name, who, when, where.
Comprehension	– understanding information – grasp meaning – translate knowledge into new context – interpret facts, compare, contrast – order, group, infer causes – predict consequences ***Question Cues:*** summarize, describe, interpret, contrast, predict, associate, distinguish, estimate, differentiate, discuss, extend.
Application	– use information – use methods, concepts, theories in new situations – solve problems using required skills or knowledge ***Questions Cues:*** apply, demonstrate, calculate, complete, illustrate, show, solve, examine, modify, relate, change, classify, experiment, discover.
Analysis	– seeing patterns – organization of parts – recognition of hidden meanings – identification of components ***Question Cues:*** analyze, separate, order, explain, connect, classify, arrange, divide, compare, select, explain, infer.
Synthesis	– use old ideas to create new ones – generalize from given facts – relate knowledge from several areas – predict, draw conclusions ***Question Cues:*** combine, integrate, modify, rearrange, substitute, plan, create, design, invent, what if?, compose, formulate, prepare, generalize, rewrite.
Evaluation	– compare and discriminate between ideas – assess value of theories, presentations – make choices based on reasoned argument – verify value of evidence – recognize subjectivity ***Question Cues*** assess, decide, rank, grade, test, measure, recommend, convince, select, judge, explain, discriminate, support, conclude, compare, summarize

Affective learning is demonstrated by behaviors indicating attitudes of awareness, interest, attention, concern and responsibility, ability to listen and respond in interactions with others, and ability to demonstrate those attitudinal characteristics or values which are appropriate to the test situation and the field of study. This domain relates to emotions, attitudes, appreciations, and values, such as enjoying, conserving, respecting, and supporting. Verbs applicable to the affective domain include accepts, attempts, challenges, defends, disputes, joins, judges, praises, questions, shares, supports, and volunteers.

Psychomotor learning is demonstrated by physical skills; coordination, dexterity, manipulation, grace, strength, speed; actions which demonstrate the fine motor skills such as use of precision instruments or tools, or actions which evidence gross motor skills such as the use of the body in dance or athletic performance. Verbs applicable to the psychomotor domain include bend, grasp, handle, operate, reach, relax, shorten, stretch, write, differentiate (by touch), express (facially), perform (skillfully).

2.4 Educational Methodologies.

There also exist a number of different methodologies that can be used to form the basis for effective instruction. Four common methods[46] will be discussed here including the Socratic, Thematic, Experiential and Competency Based instruction methodologies.

The Socratic method of instruction was employed by Socrates, a 5th Century Greek philosopher and is most notably found in the dialogues of Plato, one of Socrates' students. This method considers the art of investigating the truth by discussion and logical argument.

The development of a thesis, antithesis, and the subsequent synthesis of the two form a theory of logical reasoning and learning. The Socratic method allows adult learners to develop critical reasoning skills, take advantage of others, and seek self-education. The armed forces have successfully integrated the Socratic method into their cultures through the use of the after action review (AAR) process. Within the Army, Observer/Controllers (OCs) at the Combat Training Centers (CTCs) routinely ask soldiers and leaders to explain actions taken and opportunities missed along with the actual and potential consequences, respectively.

The Thematic Method of instruction is typically based on a scenario that sets the material in a coherent and meaningful context. The scenario is sequential and connected, much like the episodes of a television show or the chapters of a book. As the story line is developed, it is easier for the student to track the material and the context as it is being presented. Careful selection of the scenario to coincide with the student's experience can also motivate learning by helping the student understand the importance of the subject to an application they are familiar with. The narrative form of information presented in the Thematic Method is generally simpler and easier to recall than unconnected topics. Culturally, it is easier to remember a story that carries meaning and is presented in a sequential and episodic way. Although this method of instruction provides several distinct advantages for the student, it requires more work to develop a meaningful story line and ensure it is woven throughout the course in sequence.

Experiential learning is learning that typically takes place outside of the classroom. An example of experiential learning is on-the-job training. Within the context of the

classroom, practical exercises that extend fundamental concepts developed through other learning methodologies can be reinforced.

In many cases, adults learn more effectively when they understand what skills are required to perform in their jobs and more importantly, what they need to improve to be successful. Competencies are the foundations for education and training within a profession. Competency-based learning focuses on the competencies that separate average from superior performance. This model defines the competency, skills, behaviors, and supporting performance requirements that are necessary to meet the educational development of those in the profession. Within the Army, the Officer Efficiency Report (OER) defines conceptual, interpersonal, technical, and tactical competencies for officers.

2.5 Educational Issues Affecting Scientific Disciplines.

The notion that society is split between two cultures, one being the arts and humanities and the other the sciences, has a long and distinguished history. In 1959, C. P. Snow delivered the now famous Rede Lecture at Cambridge University entitled *The Two Cultures.*[47] Snow argued that England's educational elite was split between two groups, scientists and those in the arts and humanities, and that these influential groups misunderstood each other to an increasing and disturbing degree. Such mutual incomprehension, even hostility among its knowledge workers could not be good for any industrial country. This cultural antagonism continues today but is no longer confined to only the educated and intellectual elite but permeates society as a whole as the public becomes more removed from scientific and technical literacy. This cultural divide represents a challenge in educating students,

particularly adult learners, in science and technology subjects and must be considered in the development of any science and technology curriculum.

Another important issue is that different academic disciplines are organized differently and have different approaches to inquiry. The evidence needed to support a historical claim is different from the evidence needed to prove a mathematical conjecture, and both of these differ from the evidence needed to test a scientific theory.[48] Similarly, different disciplines possess different conceptual barriers that hinder students from effectively learning the subject.

Coupled with the difficulty of the subject matter is an increasing lack of understanding about science and technology. It is science and technology that for the past two hundred years have provided the distinguishing characteristics of western society.[49] In a lecture at the Museum of Technology and Work in Manheim, Germany in 1996, Neil Cossons, the Director of The Science Museum in London stated that "[science and technology] are at the foundation of our success, our prosperity, our quality of life, and increasingly our political stability and security. Yet never before in human history has anxiety about and antipathy towards science and technology been greater nor have the achievements of scientists and engineers been viewed with such suspicion."[50] Throughout the western world an increasing proportion of our population is incapable of dialog about even the simplest of scientific concepts. There is now a widespread consensus that ignorance about science and technology lies at the root of much of society's antipathy toward it.[51] For those nations where science and technology are deeply embedded in their historical as well as their contemporary cultures, and provide the mainspring of their economies, a population hostile toward science and technology increasingly represents cause for concern.

The difficulty of the vocabulary of science and technology coupled with the seemingly widespread antipathy toward it presents a significant challenge to teaching subjects in this area.

2.6 Implications of Educational Approaches and Learning Methodologies to Science and Technology Education of the Officer Corps.

The issues addressed in this chapter identify important aspects of instruction, teaching methodology, and subject anxiety in the context of increasing the technical competency of the officer corps. First, it is critical that any reform of the officer PME system move away from training toward education. The uncertainty that officers will encounter in the future makes this an imperative. Next, since the students in the officer PME system are adults and members of the Profession of Arms, instruction must embrace those precepts encompassed in andragogy. However, since junior officers lack military experience and therefore the understanding of the relevance of specific education to their profession, it is necessary to tailor the PME system to evolve from a more pedagogical approach early in the officer's career to a more andragogical approach later in an officer's career. Next, during the development of officer PME courses it is important to ensure that the course construct include development at each of the 6 levels within the cognitive domain identified by Bloom's Taxonomy. Not only will this approach improve the likelihood that the student will more effectively learn the specific material, but it will also exercise the higher-level cognitive skills that can be applied in other situations encountered by officers. Finally, the difficulty of scientific disciplines coupled with the anxiety that a majority of the population experiences

when confronted with attempting to understand scientific concepts must be considered in any modifications of the officer PME system to incorporate science and technology.

I hear and I forget. I see and I believe. I do and I understand.
— Confucius

Chapter 3. Scientific Competencies for the 21st Century.

> And one should bear in mind that there is nothing more difficult to execute, nor more dangerous to administer than to introduce a new system of things; for he who introduces it has all those who profit from the old system as his enemies, and he has only lukewarm allies in all those who might profit from the new system.
>
> — Niccolo Machiavelli, 1513 A.D.
> The Prince[52]

Today we live in a society immersed in and dependent on technological innovation. Cellular telephones, personal digital assistants (PDAs), computers, and wireless communications have become ubiquitous in modern society. These modern technological marvels provide owners with instant access to work, family, and resources nearly anywhere in the world and have fundamentally changed how people interact. The Internet, originally developed as a tool for scientists to collaborate and access high-performance computing facilities, is now routinely used by teenagers to "chat" with friends. The military is not immune from the impact of similar sweeping changes in technological innovation. Precision guided munitions, space-based reconnaissance systems, unmanned ground and air vehicles, stealth aircraft, global positioning systems, and the tactical Internet and network centric warfare all contribute to substantial increases in overall capabilities.

The driving force that enables these technological advances in both consumer electronics and military weapon systems is the electronics industrial complex. Advances in photolithography have enabled routine fabrication of silicon circuit feature sizes less than 1 micrometer (0.000001 or 10^{-6} meters; μm), which correspondingly enabled personal

computer processing speeds in excess of 1 gigahertz (1,000,000,000 or 10^9 Hertz; GHz). Improvements in lasers and fiber optic waveguides have enabled communications bandwidths in excess of tens of gigabits per second (Gbps), which allow high-speed access to the Internet that society now routinely demands. Night vision devices and second generation forward looking infrared (FLIR) systems allow unprecedented standoff detection, identification, and targeting capabilities. Never before have we as a society been so reliant on advanced technology in every aspect of life.

Yet, never before have we become so distant from and ignorant of the fundamental science that enables this technology. Technical illiteracy is an epidemic that plagues modern society. Ask an adult why the sky is blue or why the sunset is red, how the automatic toilets in public restrooms operate, how the local supermarket scanner works, or even how to program the clock in their home VCR and one gets a sense of the lack of understanding that society has about the natural world they inhabit and the technological devices they have become accustomed to and rely upon. More recently at the end of 2001, should it have come as a surprise to learn that militarized inhalation anthrax refined to 1-μm diameter spores could penetrate envelopes with gaps in the paper greater than 10-μm? This growing chasm between technical complexity and sophistication and an understanding of the underlying concepts is particularly important within the armed forces. In modern society, individuals can rely upon scientists and engineers to continue to provide more capable innovations. Within the armed forces, however, the tactics and doctrine for the employment of these technologically advanced weapon systems are developed by the military themselves. A lack of understanding of science and technology is an inconvenience for civilians but can be fatal on the battlefield.

3.1 Revolutions in Military Affairs and the Role of Technical Competency.

In order to understand the key role technical competency played in the successful integration and employment of technology to warfare, it is instructive to consider several historical RMAs that have enabled significant changes in warfare and victory to the side that first achieved the technological, operational, and organizational change necessary to enable the RMA.

The student of military history can identify a number of distinct RMAs throughout the history of modern warfare, many of which have been enabled by technological innovation. The invention of the stirrup revolutionized warfare by allowing armed men to engage in combat from horseback. Other technological innovations such as the long bow, the musket, the machine gun, the radio, radar, the aircraft, and nuclear propulsion and explosives each radically changed the way wars were waged. However, technological innovation is not a prerequisite for a successful RMA. Napoleon's *levee-en-mass* is an example of a successful RMA based on organizational change.

The period between 1850 and 1900 witnessed significant social and political change as well as change in the technology and doctrine employed to wage war. Napoleon's *levee-en-masse* radically changed the nature of warfare by significantly increasing the size of armies used in the conduct of war and marked the beginning of a professional officer corps. Napoleon was able, for the first time, to raise a mass army in excess of a million men, which subsequently required the development of an organizational structure to manage it. Napoleon was the first to conceive of the modern field army organization comprising army corps and divisions. However, Napoleon also incorporated technological innovation in this

RMA. He took advantage of advances in artillery by forming independent, mobile artillery units that supported the large infantry formations. Napoleon was able to lead this RMA by integrating the weapons technology of the age into a consistent pattern of military theory, organization, and leadership.[53] Douglas Macgregor concluded that "This congruence of French weapons, tactics, organization and thinking about war reflected Napoleon's understanding of how to use existing technology to the limit and at the same time make its very limitations work to French advantage."

The French first employed railroads for large-scale troop movement and supply in the late 1850s.[54] Later, the Prussians under Helmut von Moltke defined their importance in military mobilization and deployment in the war against Austria in 1866 and against France in 1870. During this same period, the telegraph allowed rapid communications with armies dispersed over large distances and rifled barrels changed the range and effectiveness of both individual weapons and artillery. Doctrine also changed to enable tactical and operational maneuver and to take advantage of dispersed units and the increased range and accuracy of new weapons. All of these changes in warfare taken together significantly increased the complexity of preparing for and conducting war. Prussia was the first to recognize the importance and complexity of these changes and the need for a professional staff to plan and execute military operations. It was the education and subsequent effectiveness of the officers of the Prussian General Staff that enabled the successful transformation of the Prussian Army that led to the military successes over Austria and France in 1866 and 1870, respectively.

For many scholars and students of military history, the development of mechanized warfare between 1918 and 1941 provides the prototypical example of a successful RMA. In the years after World War I, two British officers, J. F. C. Fuller and Basil Liddell-Hart,[55]

were the world's most vocal advocates of armored warfare while Great Britain led the world in tank technology. However, it was Germany that first embraced the new technological innovation and closely coupled it with a corresponding transformation in military organization and tactics resulting in devastating effects against Poland in 1939, France in 1940, and the Soviet Union in 1941.

The German's new approach to armored warfare combined technological, operational, and organizational changes. German tanks were equipped with radios to allow close coordination of armored operations. New operational concepts emphasized deep penetration of enemy lines and subsequent attacks on command and control and logistics networks. Organizational changes included the new Panzer division, which combined armor with infantry, artillery, engineers, and signal troops. *Blitzkrieg* combined the use of close air support, radio communications, and armor divisions to achieve rapid and decisive victory.

There are several factors that contributed to Germany's achievement of this RMA in armored warfare. The Treaty of Versailles limited the German army to 100,000 men, 4,000 of whom were officers; therefore, the German leadership had to determine the composition of the postwar officer corps. A report to the German Army High Command after World War I suggested that the General Staff had been filled with tacticians and was void of technologists, analysts, or grand strategists.[56] As a result, a conscious decision was made to retain highly educated staff officers rather than veteran combat officers. These staff officers were then employed to carefully study the outcomes of World War I and identify lessons learned that formed the basis for a new doctrine based on maneuver and offensive operations.

The German High Command further realized that the German War College was incapable of providing the education that would adequately prepare the General Staff with

the skills and knowledge to deal with the uncertainties of the post-war environment. Consequently, the German military leadership sent German General Staff students to civilian education courses at German universities as part of their training.[57] Macgregor argues that this educational program introduced General Staff officers to new concepts in aviation, automotive technology, rocketry, and radio and was a contributing factor in explaining why German wartime commanders were initially ahead of their adversaries in understanding military strategy and technology.

In contrast to the German military culture that embraced change and innovation, the British army was profoundly anti-intellectual and discouraged any serious study of the lessons of World War I or thoughts of military innovation. The characteristic of the British military during the interwar period was one in which intellectualism was scorned. Michael Howard suggested that "the evidence is strong that the army was still firmly geared to the pace and perspective of regimental soldiering as it had been before 1914; that too many of its members looked on soldiering as an agreeable and honorable occupation rather than a serious profession demanding no less intellectual dedication than that of the doctor, lawyer, or the engineer."[58] The British military culture "engendered a 'muddy boots' approach to soldiering, one that regarded intellectual effort with contempt and retarded an understanding of operations beyond battalion level. Moreover, the British professional military education system was incapable of lifting officers' understanding of the concerns of regimental soldiering."[59] This environment must be viewed as a major contributing factor to the British lost opportunity in armored warfare.

The point of this discussion is that throughout history it was the military leaders that truly understood technological innovation coupled with a culture that encouraged creative

thinking that enabled the RMA. Technology alone is insufficient to produce an RMA. It is *how* the technology is used and integrated into organizational and operational change that enables an effective RMA. Without the understanding of both the military doctrine and application and the technological innovation, no RMA would have occurred.

3.2 Modern Weapon Systems and the Underlying Science.

It is neither practical nor desirable that every officer in the armed forces understands all science and technology known to mankind. An endeavor of this magnitude would require that all officers pursue advanced academic studies in the applied physical sciences, achieving an understanding of the subjects that would make them scientists and engineers rather than practitioners of the art of war. Instead, it is that science that specifically enables current and near-term military systems that is of central importance to their professional competency. It is this science that will allow commanders to understand the capabilities and limitations of weapon systems thereby allowing them to effectively employ those weapon systems. It is also this understanding that will provide military leaders with the ability to identify key technological innovations, reduce organizational resistance, and enable evolution, transformation, and future RMAs.

Science and technology is currently integrated into modern military systems to reduce platform size and weight while increasing the lethality and survivability necessary for full-spectrum dominance. The general categories of technological innovations being leveraged include computer, communication, and network technologies for the network-centric component, advanced and distributed sensors that span the acoustic and electromagnetic

spectrums to provide improved detection, tracking, and targeting, composite materials that reduce the overall weight while maintaining or improving the capabilities of the protective armor, stealth technology to reduce the radar cross-section of platforms, electric and hybrid power systems for propulsion and weapons, and many others.

Within the context of the current military enterprise, several sciences dominate the landscape of modern military systems. Information technology and communication systems, the science associated with sensor systems, fundamentals of chemistry, biotechnology, and nuclear energy and radiation, and what can best be described as military physics and engineering. Additionally, since the common vernacular of science and technology is rooted in mathematics, a final category dealing with quantitative and analytic skills is also included.

Information technology and communication networks are now ubiquitous and represent the single common technological theme throughout the armed services intended to provide revolutionary improvement in warfighting capabilities. The Army's tactical Internet and the Navy's embodiment of network centric warfare in FORCEnet[60] are enabled by advances in computing, information technology, and communications networks pioneered during the 20th Century. The Marine Corps has developed palm-top computers based on Apple Computer's Newton technology[61] and have completed a three-year series of experimental exercises called *Urban Warrior*. This focus on experimentation within the Marine Corps will continue through *Capable Warrior*, *Information Warrior*, *Coalition Warrior*, and *Future Warrior*.[62] Arguably, every officer in the armed forces, whether an infantry or finance officer in the Army, or an aviator in the Navy, or a maintenance officer in the Air Force, or an artillery officer in the Marine Corps, all require an understanding of the fundamentals that enable these distributed information systems. Because of the importance

of information technology and communication networks to all of the Services, education and training related to these systems has also begun to receive considerable attention. A 1997 Center for Strategic and International Studies Report recommended information technology education that includes "competencies ranging from computers and the Internet to familiarity with war-gaming and simulations."[63] More recently, the Chief of Naval Operations (CNO) Strategic Studies Group XX identified critical competencies for the FORCEnet Warrior that focused on understanding information technology and communication networks.[64]

In addition to information technology and communications, sensor systems have also become integral to modern warfare. To achieve the desired level of battlefield visualization, the modern common operational picture must include information about both friendly and enemy units. Sensors provide the interface between the natural environment and target detection, identification, classification and visualization systems. Sensor systems must first sense key information and then format the information for effective and efficient communication or storage. Understanding how sensor systems operate provides users with critical information about limitations associated with the natural environment such as rain, snow, and fog and the impact of obscurants employed by the enemy to deny friendly use of this information. Since the natural environment is analog and the preferred method of communicating, processing, and storing information is digital, there is a need to convert from an analog to a digital signal format. The electromagnetic spectrum is a fundamental concept that is central to both communications and sensors and is essential to understanding the advantages and limitations of these applications. The Army has institutionalized in *Force XXI Operations*, "Components of [the battlespace] are determined by the maximum capabilities of friendly and enemy forces to acquire and dominate each other by fire and

maneuver and in the electromagnetic spectrum."[65] Clearly, officers who must implement Army doctrine that specifies dominance of the electromagnetic spectrum must first understand the electromagnetic spectrum.

Additionally, while there has always been a need to understand the fundamentals of chemistry, chemical and biological agents, and nuclear effects, this area takes on increased relevance and importance in the current strategic environment. Weapons of mass destruction (WMD) are increasingly the choice of non-state actors and are likely to be employed as an asymmetric response to conventional U.S. military power. As a result, officers need to understand fundamental scientific concepts that enable these types of weapons. Understanding the physical dimension of molecules associated with the different types of chemical and biological agents will provide insights about sensor selection to detect and the propagation of these agents. Additionally, understanding the underlying concepts associated with the chemistry of explosives and propellants would also provide additional insights about many diverse weapon systems.

The final category of scientific application can best be described as general military physics and engineering. Concepts associated with understanding the aerodynamics of aircraft and UAVs, power generation and storage, the physics of demolition, fundamental structural analysis of bridges, fortifications, and structures, basic material science, and to a lesser extent, elementary thermodynamics, are included in this final category.

In addition to the categories of scientific application, a category that encompasses quantitative and analytic skills is also included. Since officers are routinely required to collect, analyze, and present numerical data, this category is another core competency required of all officers. Topics in this category include subjects from common metric units,

basic algebra, trigonometry, analytic geometry, and probability and statistics. Examples of the application of common numerical analysis and presentation software should also be included.

3.3 Core Technical Competencies for the New Millennium.

In developing the core technical competencies required of officers, a fairly broad survey of technical experts was conducted. A workshop was held at Duke University in March 2002 with faculty from Duke University, the University of North Carolina, and North Carolina State University, and program managers from the Army Research Office (ARO) to identify officer technical competencies. Additionally, all program managers from ARO, spanning a diverse spectrum of science and technology application, were polled for their input on technical competencies. Furthermore, faculty from the math, science and engineering disciplines at the United States Military Academy at West Point also provided input.

Refinement of the broad general categories of the scientific applications presented in the previous section helped to identify the core technical competencies required of officers in the new millennium. The following topics are not intended to be all-inclusive of the subject areas, but instead are representative of the types of subjects that should be included in any educational courses intended to increase the technical competency of the officer corps. These subjects will necessarily change as advances in science and research and development improve the technology of future weapon systems.

3.3.1 Information Technology and Communication Networks. The subjects covered in this category include the broad general category of computer access and applications, communications, information storage, information processing and computation, and displays and visualization technologies. Recent interest in this specific area within the commercial sector and the greater academic community provides a number of existing resources[66,67] that can be used to develop courses suited to officers in the Armed Forces.

3.3.1.1 Information Technology.

- Components of a computer system
- Accessing programs and applications
- Accessing the network

3.3.1.2 Moving Information – Communications.

Signaling

- Modulation schemes
  - Amplitude modulation (AM)
  - Frequency modulation (FM)
  - Digital modulation
- Timing accuracy and digital systems
  - Global positioning system (GPS)
- Multiplexing and demultiplexing
  - Time division
  - Frequency division
  - Code division
- Coding and compression
  - Linear block coding
  - Coding as an approach to increase redundancy

Compression as an approach to reduce redundancy

Encryption

Non-linear encryption for information security

Public key encryption

The Communication Channel

- Description of different methods of guiding energy
  - Cable: coax, twisted-pair
  - Waveguide
  - Fiber optic
- Free-space communication
  - Microwave
  - Radio frequency (RF)
  - Optical
- Transducers
  - Cable-to-RF conversion.
  - Fiber optic-to-microwave conversion.
- Channel capacity and Shannon's theoretical limit.
- Noise
  - White noise and thermal noise models
  - Signal-to-noise ratio (SNR) evaluation

Communication Networks and Protocols

- The transmission control protocol Internet protocol (TCP/IP) model
- Routed and broadcast protocols
- The local area network (LAN)
  - Ethernet
  - Switched Ethernet
  - Fiber distributed data interface (FDDI)
- The wide area network (WAN)
  - Circuit switched networks

Packet switched networks

- The Internet and the world wide web (WWW)
- Security

3.3.1.3 Information Storage.

- Types of storage
- Sizing storage to problem requirements
- Fundamental limits

3.3.1.4 Processing, Analysis, and Computation.

- Aspects of processing speeds
- What is a floating point operation (FLOP)?

  How many FLOPS required for data base operation?

  How many FLOPS for correlation?

  How many to break encryption codes?
- Microcontrollers, microprocessors, and computers

  Definitions and comparisons

  Hierarchy of capabilities (PDAs, embedded, workstation, server, and high performance computing systems)
- Introduction to transform domain processing

  Exploiting Fourier analysis for frequency domain analysis

  Example of gun tube size from spectrum analysis

  Example of helicopter rotor signature

3.3.1.5 Displays and Visualization.

- Human visual system and discrimination
- Color response
- False color encoding
- Resolution

  Photographic picture quality (2500 dots per inch)

  Photographic printed (1200 dpi)

Display technology (600×800 pixels)

Resolution comparison: pixels and dots per inch (dpi).

- Sensor fusion
- Prioritization of information

3.3.1.6 Information Operations and Warfare.

- Information security
- Defensive information operations
- Offensive information operations

3.3.2 Sensor Science. The subjects covered in this category include the electromagnetic spectrum, the acoustic spectrum, types of signals, propagation of signals, effects of natural and manmade obscurants, and types of sensors.

- The electromagnetic spectrum
- The acoustic spectrum
- Attenuation, absorption, scattering, and diffraction
- The diffraction limit and resolution
- Reflection and emission
- The sampling (Nyquist) theorem
- Quantization and analog-to-digital (A/D) conversion
- Active and passive sensing and imaging
- Generalized sensing model
- Probability of detection
- Stealth technology

3.3.3 Chemistry, Biotechnology, and Nuclear Radiation. Representative subjects covered in this category include applications of chemistry to the military, fundamentals of biotechnology and the application to biological weapons, and understanding nuclear radiation and its effects.

3.3.3.1 Military applications of chemistry.

- Interactions between matter and energy
- Chemistry of materials
  - Dependence on temperature, humidity, salinity, pH
  - Critical mass, exothermic and endothermic reactions
  - Corrosion
- Chemistry of explosives
- Chemistry of propellants

3.3.3.2 Biotechnology.

- Chemical basis of life and biotechnology
- Living organisms and non-living matter
- Organization and diversity of living organisms
  - Toxicology and antidotes
  - Fatigue
  - Exposure
    - Symptoms of exposure to toxins, sun, radiation

3.3.3.3 Nuclear Energy and Radiation.

- Nuclear energy and the nature of radioactivity
  - Radiation exposure and doses
  - Radiation shielding
- Electromagnetic pulse

3.3.4 Military Physics and Engineering. The subjects covered in this category include issues from several different disciplines including physics, electrical engineering, aeronautical engineering, civil and mechanical engineering, and material sciences.

- Aerodynamics
- Power generation and storage
  - Power sources
  - Types of batteries

Recharging

Fuel cells and solar cells

- Physics of demolition

  Force and momentum

  Understanding explosions

  Matching explosive effects and targets

- Structural fundamentals

  Statics

  Compressive and tensile strength

  Structures of construction

- Fundamentals of material science

  Types of materials

    Structural properties

    Electrical properties

    Anisotropic materials including composites

  Behavior of materials

    Thermal expansion

    Solubility

    Corrosion resistance

  Defects in materials

    Aging and fatigue

    Thermal stresses

- Heat and energy transfer

    Heat capacity and thermal insulation

3.3.5 Quantitative and Analytic Skills. These skills represent common mathematical skills necessary to conduct the daily business of the Armed Forces. Subjects in this category include quantitative and analytic subject that better prepare officers to understand numerical analysis and presentation of data and the underlying qualitative knowledge of estimation based on order-of-magnitude analysis.

- Algebra
- Trigonometry
- Analytic geometry
- Probability and statistics
- Numerical software applications

Chapter 4. The Army Professional Military Education System and Technical Education.

The Army has a well-established PME system that provides for the development of officers throughout their career. The instruction in the PME system is progressive and sequential and builds upon the skills, knowledge, and experience acquired through previous training and operational assignments.[68] Officer education occurs in institutional training, in units, and through self-development. Institutional training represents the resident training an officer receives through military or civilian institutions. In units, officers participate in regular officer professional development (OPD) sessions and gain experience by active participation in their profession. Self-development encompasses nonresident schooling including individual study, research, professional reading, practice and self-assessment.

The Army PME system is graphically represented in Figure 4.1. Here the major resident PME courses including the Officer Basic Course (OBC), the Captain's Career Course, Command and General Staff College (CGSC) and the Senior Service College (SSC) are shown. Both Battalion and Brigade Pre-Command Courses are also identified. Overlaid throughout an officer's career are professional reading, correspondence courses, distance learning and professional development that take place at the unit level.

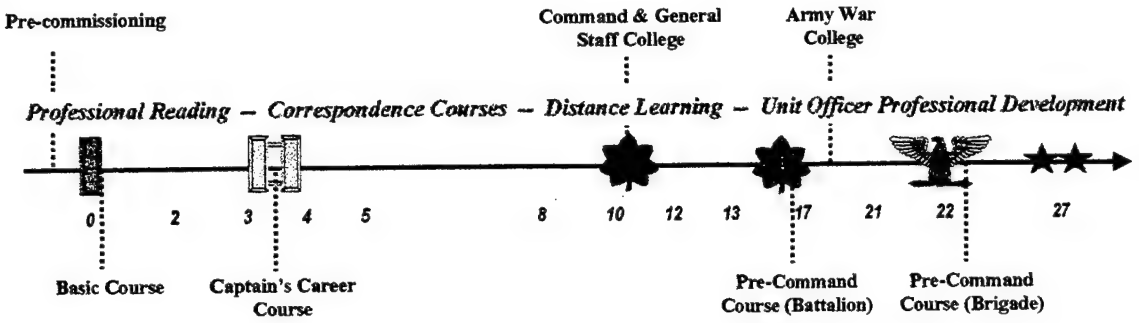

Figure 4.1. Army Officer Professional Military Education System.

4.1 Officer Basic Course.

The Officer Basic Course provides newly commissioned officers with the skills needed to lead platoon-sized units. Additionally, the course provides officers with a detailed understanding of equipment, tactics, organization and administration at the company, battery or troop level. The Officer Basic Course provides different subject coverage depending on the specific branch of the Army. For completeness, the branches of the Army are listed in Table 4.1.

The Officer Basic Course can be loosely characterized as an entry-level trade school for Army officers. Infantry officers study small-unit tactics, weapons, and doctrine specific to the Infantry and applied at the platoon and company level. Signal Corps officers study communication systems found at the platoon and company level. Although each of the Officer Basic Courses are focused on providing skills and knowledge necessary for successful leadership in each of the specific branches of the Army, each also contains a common core of subjects that represent those skills and knowledge required of all officers in the U.S. Army. Table 4.2 identifies the 96 hours of common core instruction covered at the Signal Officer Basic Course.[69]

Table 4.1. The Branches of the Army and Associated Specialty Codes.

Combat Arms Branches and Specialty Codes.	**Combat Service Support Branches and Specialty Codes.**
Infantry (11)	Adjutant General Corps (42)
Armor (12)	Finance Corps (44)
Field Artillery (13)	Transportation Corps (88)
Air Defense Artillery (14)	Ordnance Corps (91)
Aviation (15)	Quartermaster Corps (92)
Special Forces (18)	
Corps of Engineers (21)	
Combat Support Branches and Specialty Codes.	**Special Branches and Specialty Codes.**
Signal Corps (25)	Judge Advocate General Corps (55)
Military Police Corps (31)	Chaplain Corps (56)
Military Intelligence Corps (35)	Medical Corps (60-62)
Civil Affairs (RC only) (38)	Dental Corps (63)
Chemical Corps (74)	Veterinary Corps (64)
	Army Medical Specialists (65)
	Army Nurse Corps (66)
	Medical Service Corps (67-68)

Table 4.2. Common Core Subjects and Number of Hours Covered at the Officer Basic Course.

Communications Skills	8	Drug and Alcohol Abuse	1
Military Justice	8	Field Sanitation	2
EO/Sexual Harassment	4	Medical Evacuation	1
Role & Use of Military History in Officer Professional Development	2	Safety and Risk Assessment	2
History of Signal Corps	4	Common Core Mid-Phase Exam	2
Battle Analysis	2	Introduction to Force XXI	2
Total Fitness	4	Army Operations Doctrine	2
Officer Evaluation Reporting System	2	The Combat Force	3
Leadership	18	Tactical Operations	5
Stress Management	1	The Threat	2
Suicide Prevention	1	Combating Terrorism	1
Army Family Team Building	2	NBC Operations	6
Training Management	8	Decision Making Plans/Orders/Troop Leading Procedures	2
Enlisted Personnel Management System	3	Common Core End-of-Phase Exam	2
			96

4.2 Captain's Career Course.

This is the second major branch school officers attend before company level command. The course combines the instruction formerly taught in the branch Officer Advanced Course (OAC) and the Combined Arms and Services Staff School (CAS3). This training prepares officers to command and train at the company, battery or troop level and to serve as staff officers at the battalion and brigade levels. The first phase of the course is 18 weeks of branch-specific technical and tactical instruction. The second phase is a 6-week staff process phase that uses battalion, brigade, division, and installation scenarios to train officers to serve on battalion and brigade level staffs. It develops officers to function as staff officers by improving their abilities to analyze and solve military problems, communicate, interact as staff members and broaden their understanding of Army operations, organizations and procedures. This second phase, taught at Fort Leavenworth, is unique in that it is the first time an officer receives integrated instruction with officers from different branches of the Army. The course provides the skills necessary for success in single service, joint and multinational environments[70].

4.3 Command and General Staff College.

The Command and General Staff Officer Course (CGSOC) within the Command and General Staff College provides intermediate level leadership development and PME, and prepares officers to serve as field-grade commanders and staff officers, primarily at brigade and higher echelons. The resident CGSOC is a 10-month program consisting of a common

curriculum, advanced applications courses, and a comprehensive capstone exercise.[71] The common curriculum constitutes the basic academic program undertaken by all students in the CGSOC. Foundation Studies is the common core curriculum taught during Term I with the exception of the Evolution of Modern Warfare, which spans all four terms. Advanced Applications studies are taught in Terms II, III, and IV.

4.3.1 Foundation Studies.

Foundation Studies represents the basic academic courses taken by all students CGSOC. Academic instruction in fundamentals of warfighting, resource planning and force management, fundamentals of operational warfighting, and leadership is presented during Term I. Table 4.3 describes each of the courses in the Foundation Studies and includes the number of hours dedicated to each subject.

Table 4.3. Foundation Studies in the CGSOC Curriculum.

C300--Fundamentals of Warfighting	**165 hours**
This course serves as the foundation for all combined arms instruction within the resident CGSOC. In general, the lessons in C300 expose the students to U.S. Army warfighting doctrine and provide an opportunity to analyze how corps, divisions, and brigades fight and sustain themselves on the battlefield. The course is designed to teach students standard U.S. Army techniques and procedures for tactical decision-making and to understand how commanders and their staffs plan and conduct combat operations at corps, division, and brigade within the context of the operational level.	
C400--Resource Planning and Force Management	**38 hours**
This course is a study of the processes used to determine force requirements and alternative means of resourcing requirements. The course concentrates on how the Army builds a capable force by structuring, manning, equipping, training, sustaining, stationing, deploying, and funding organizations.	
C500--Fundamentals of Operational Warfighting	**130 hours**
This course begins with an introduction to strategic concepts and DOD systems and structures that are the foundation for operations. Students will study the complexity of the international security environment, U.S. national interests and objectives, national- and theater-level strategies, the Defense Planning System (DPS), national- and theater-level command and control systems, strategic logistics, force mobilization and deployment, multinational operations, the range of military operations, and operational planning concepts. Students will also study the roles, functions, organization, capabilities, and limitations of the military services, Special Operations Forces, and examine the nation's space capabilities. It focuses on analyzing and synthesizing the fundamentals of campaign planning, and on understanding planning processes in both deliberate and crisis action planning environments.	

C600--The Evolution of Modern Warfare	54 hours
This course surveys and analyzes the evolution of modern warfare and military operations other than war in terms of theory, art, and practice from the age of limited warfare in the 17th century to the present day. The course introduces the CGSOC students to military theory and its relationship to military history, principles, and doctrine. It employs critical analysis to demonstrate and test historical trends in military thought and practice and to illuminate current operational issues.	
C700—Fundamentals of Excellence: Character and Competence	**64 hours**
This is a CGSOC leadership course focusing on organizational level leadership. The course goal is to prepare officers to lead and fight units at higher levels by possessing and communicating an organizational-level perspective of leadership, training, public affairs, and military law. Leaders are challenged to think critically and creatively as they explore what it means to be *leaders of character and competence* in a values-based organization. Central to accomplishing these goals are the CSA's three fundamental, timeless leadership principles: *do what' s right legally and morally everyday, create an environment where people can be all they can be, and treat others as you want them to treat you.*	

4.3.2 Advanced Applications Program.

The Advanced Applications Program is effectively an electives program at CGSOC and consists of several components including areas of concentration, focused programs, graduate degree programs, unrestricted advanced applications courses, and a capstone tactical exercise.

The majority of electives courses in the Advanced Applications Program are listed in Table 4.4. After evaluating each of the course descriptions, those that contain mathematics, science, or technology subjects are identified in bold.

Table 4.4a. Center for Army Tactics Electives.

A301	Heavy Division Operations	A314	German Army General Staff College Exchange
A303	Light Division Operations	A316	Canadian Forces College Exchange
A304	Fire Support for Non Artillerymen	A318	Prairie Warrior Corps Planning Seminar
A306	Maneuver Brigade Warfighting for the S3/XO	A320	Stability Operations and Support Operations
A307	**Advanced Communications**	A334	Maneuver Control System
A308	Advanced Warfighting (Digitized)	A335	Advanced Intelligence Training
A309	Tactics and Operations Research Project I	**A336**	**NBC in the 21st Century**
A310	Automated Tactics and Operations Research	A337	Advanced Air Defense Training
A311	Interim Brigade Operations	A338	Digital Fire Support Training
A312	French Staff College CPX	A339	Advanced Intelligence Seminar
A313	Belgium Forces College Exchange	A392	Prairie Warrior OPFOR
		A393	Prairie Warrior Division OPFOR
		A395	Prairie Warrior Support

Table 4.4b. Department of Logistics and Resource Operations Electives.

A401	Introduction to Advanced Logistics	A434	Advanced Acquisition Seminar
A408	Sustaining the Digitized Division	A450	Logistics Automation
A417	Prairie Warrior Research Project	A451	Topics in Operational Decision Making
A418	Prairie Warrior Corps Logistics Planning Seminar	A452	Force Projection of Combat Power - Logistics
A421	Prairie Warrior Operational Logistics Planning Seminar	**A453**	**Quantitative Methods in Personnel and Logistics**
A422	**Military Operations Research I**	A554	Middle East Strategic Study
A423	Fundamentals of Contracting	A455	Army Resource Management
A424	Fundamentals of Contract Pricing	A456	CGSC-Industry Partnership Program
A425	Intermediate Systems Acquisition	A457	Logistics and Resource Research Project
A426	Intermediate Information System Acquisition	A458	Human Resources Support Seminar
A427	Intermediate Contract Pricing	A459	Corps Logistics
A428	Introduction To SMART	A462	Combat Health Support Seminar
A429	Contingency Contracting	A463	Combat Health Support Operations
A430	Program Management Tools	A491	Logistics for Executive Officers
A431	**Military Operations Research II**	A492	Support Operations
A432	Advanced Financial Management	A493	Stability and Support Operations
A433	Combat Service Support Control System	A496	Contractors on the Battlefield

Table 4.4c. Department of Joint and Multinational Operations Electives.

A501	Research in Joint and Multinational Operations	**A543**	**Space Operations**
A502	The German Armed Forces and European Security Environment	**A544**	**Information Operations**
A503	Combined Humanitarian Assistance Response Team	A545	CIA and the Intelligence Community: How it Works With and Supports the U.S. Military
A504	Defending the Homeland	**A546**	**Applications of Information Operations**
A512	National Security Policy Formulation	A551	Pacific Strategic Environment
A514	Current Strategic Concepts	A552	Northeast Asia: A Strategic and Operational Overview
A517	Diplomatic Instrument of Power	A553	China: Military Art, War and Revolutions, and The People's Liberation Army
A521	Peacetime Military Engagement (PME)	A555	Korea: An Operational Analysis
A522	Peace Operations	A561	Post-Cold War Western European Security
A523	Humanitarian Assistance Operations	A562	Africa Strategic Studies
A527	Counterinsurgency Doctrine and Operations	A565	Post-Cold War Europe: And Eurasia
A528	Roots and Causes of Conflict: Why People Fight	A567	Lighting the Long Fuse: US Policy Strategy, and The Fall of Yugoslavia
A529	Combating Terrorism and Force Protection	A568	Latin America and Caribbean Strategic Study

A531	Advanced Operational Warfighting	A570	Special Operations Independent Research
A532	Joint Targeting	A572	Special Operations Forces Advanced Studies
A533	Joint Task Force Operations	A573	Joint PSYOP Task Force Planning Seminar
A534	Joint Force Command	A574	Joint Special Operations Task Force (JSOTF) Planning Seminar
A535	Advanced Joint Operations Planning	A575	Special Forces Company Commander, S-3, Executive Officer Course
A537	**Space Orientation**	A576	Asymmetrical Threat and Counterinsurgency Planning Seminar
A540	Army Global Command and Control System-Army (GCCS-A)	A578	Fundamentals of Civil Affairs and PSYOP
A541	Advanced Global Command and Control Systems Applications (GCCS)	A580	Religious Impact on Military Operations
		A597	Research In Terrorism

Table 4.4d. Combat Studies Institute Electives.

A621	20th Century Urban Operations	A657	Topics in Military History (Research)
A622	Origins of the American Army 1607-1815	A658	Irregular Warfare
A629	World War I	A659	German Military History
A630	The African-American Military Experience from 1775 to Present	A660	The American Civil War for International Officers
A636	Men in Battle	A677	TRADOC Commander Mentor Program
A640	History of Logistics	A686	Military History Through Simulations ("Panzers and Pentiums")
A644	The Balkan Quagmire	A691	The Second World War in Europe
A645	Case Studies in U.S. Peace Operations & Interventions	A692	World War II: The Pacific
A650	The Korean War	A694	Russian/Soviet Military History
A652	The Art of War in the Middle East	A695	The American Experience in Vietnam
A653	East Asian Military History	A697	Napoleonic Warfare
A654	The American Civil War	A698	Great Campaigns
		A699	The Evolution of Military Thought

Table 4.4e. Center for Army Leadership Electives.

A713	Military Ethics Seminar	A742	Military Criminal Law for Commanders
A714	Improving Military Decision Making Skills	A743	Case Studies in the Law of War
A715	Leadership In Battle	A744	Special Law Project
A716	**Leading the Army Through Change**	A745	Legal Issues in Contingency Operations
A717	Transformational Leadership	A746	Rules of Engagement
A731	Training in Units	A751	Military and the Media
A733	**Training With Simulations**	A753	Public Affairs in Operational Planning
A741	Administrative Law for Commanders	A794	Research In Military Law
		A799	Leadership and Training Project

Table 4.4f. University Programs Electives.

U254	Government Contract Law	**U272**	**Integrated Studies in Computer Resources and Information Management**
U261	**Computer Security**	U278	Acquisition Law
U262	**Internet Management Applications**	U280	Operations Management
U266	System Analysis, Design and Implementation	U282	Pricing
U268	Database Management	U284	Negotiations
U270	**Network and Telecommunications Management**	U285	Logistics
		U286	Integrated Studies in Procurement and Acquisition Management

4.4 Army War College.

The Army War College (AWC) is the final major military educational program available to prepare officers for the positions of greatest responsibility in the Department of Defense. This course provides senior level leadership development and PME. The AWC prepares military, civilian and international leaders to assume strategic leadership responsibilities in military or national security organizations; educates students about employment of the U.S. Army as part of a unified, joint or multi-national force in support of the national military strategy; researches operational and strategic issues; and, conducts outreach programs that benefit the nation.[72]

4.4.1 Core Curriculum.

The 10-month AWC curriculum is divided into three terms. During Term I, students take four primary core courses including Strategic Leadership; War, National Policy, and Strategy; Joint Processes and Landpower Development; and Implementing National Military Strategy. During Term II students take three elective courses, the Regional Strategic Appraisals, and the Strategic Crisis Exercise. Term III consists of four elective courses and

is followed by the National Security Seminar Week. Again, throughout the following tables, those courses that include subjects related to science and technology are presented in bold.

4.4.1.1 Strategic Leadership.

This course focuses on the uniqueness of strategic leadership; demonstrating the importance of values-based ethical behavior, decision-making, and culture setting; evaluating historical leaders in the context of the strategic environment, competencies and skills; and applying the fundamental learning and critical thinking techniques.

Table 4.5. Strategic Leadership Lesson Coverage.

Course Introduction	Strategic Vision
Introduction to Strategic Leadership	**Systems Thinking**
Critical Thinking	Leading Change
Organizational Culture	Understanding Group Processes
Ethics of Military Profession	Capitalizing on Diversity
Just War Theory	Negotiations
Leadership in and of a Profession	Negotiations Exercise
Mentoring and the Military Profession	Applications I: Strategic Leadership in a Transforming Organization
Future Environment	Applications II: Strategic Leadership in a Transforming Organization

4.4.1.2 War, National Policy and Strategy.

This course is devoted to the strategic art and grand strategy. It develops a broad common understanding of the evolution of the modern nation-state, an understanding of the fundamental nature of war, and insights into how states and other actors use force to pursue their interests. It includes the study of war, national security policy, and national security and national military strategies.

4.4.1.2.1 War, Grand Strategy, and the Security Environment. This course examines the nature of war, conflict and strategy, and their place in the international political system.

4.4.1.2.2 National Security Policy and Decision Making. This course provides a systematic study of the principal players and processes involved in the formulation and execution of U.S. national security policy including the interactions of the President, Congress, the media, and the National Security Council. This course also includes interagency processes and the issue of civil-military relations.

4.4.1.2.3 Sources and Evolution of Strategy. This course examines classical strategists and the evolution of 19th and 20th Century strategy, from the Napoleonic Wars through the Persian Gulf War. It also examines the issue of revolutions in military affairs and transformation during the interwar years and the post-WW II advent of nuclear weapons.

4.4.1.2.4 Current and Future Strategy and Defense Issues. This course begins with an assessment of the current U.S. national security and national military strategies. It also focuses on current strategic issues such as responding across the full spectrum of conventional operations, deterrence, weapons of mass destruction, and transformation. It includes seminars on the future of strategy, and an exercise in designing a future National Security Strategy.

4.4.1.3 Joint Processes and Landpower Development.

This course provides an understanding of national interests and use of elements of power to support them. It introduces a methodology and model for developing strategy, and applying the elements of power to achieve national interests. Specific focus is on the use of military power. It provides an overview of the basic concepts of strategy and focuses on key theories of classical land, sea, and air power strategists. Table 4.6 lists the lesson coverage for the Joint Processes and Landpower Development Course.

Table 4.6. Joint Processes and Landpower Development Lesson Coverage.

Joint Processes and Landpower Development	Manning the Force and Personnel Management Panel
Defense Organization	Military Assistance to Civil Authorities Exercise
Joint Strategic Planning System	Army Components
Joint Requirements: JROC, JWCA, IPL	PPBS and PPBES
Unified Command Plan	Healthcare Aspects of Well Being
Joint Strategic Capabilities Plan (JSCP)	Army Leader Day
CINC and Service Readiness	Programming Exercise
Requirements Determination	Force Planning Exercise
Science, Technology, and Transformation	Trends in the Federal Budget
Mobilization	

4.4.1.4 Implementing National Military Strategy.

This course describes the U. S. system for the formulation of national security policy and national security strategy. Table 4.7 identifies the lesson coverage for Implementing National Military Strategy.

Table 4.7. Implementing National Military Strategy Lesson Coverage.

Naval Force Employment	Multinational Operations
Marine Force Employment	Joint Land Employment
Air Force Support to the CINC	Theater Air Employment
Introduction, JOPES	Joint Force Maritime Component Command
Theater Strategy	Joint Forces Air Component Commander
Operational Art	Theater Intelligence
Campaign Planning	Strategic Mobility
Arab-Israeli Case Study	Joint Force Projection
Army Force Employment	Military Operations Other Than War
Army In The Theater	**Information Operations**
Army Component Planning	**Space Operations**
Special Ops Support to the CINC	Doctrinal Review
Theater Organization	**Future Warfare**
Joint Theater Logistics	**Transformation**

4.4.2 Electives Program.

The Army War College Elective Program provides an extensive offering of elective courses. The resident program consisting of a total of 70 electives offered during Term II and 91 electives offered during Term III. Tables 4.8 and 4.9 list representative elective courses offered in the Army War College Elective Program.

Table 4.8. Department of Command, Leadership, and Management (DCLM) Electives.

100	Dynamic Challenges for Strategic Leaders
101	**Executive Overview of Research, Development, and Acquisition Management**
102	**RDA Management for the Acquisition Corps Officer**
103	Human Relations for Strategic Leaders
104	Mobilization Management and Industrial Preparedness
105	Planning, Programming, and Budgeting System
106	Joint Issues and Processes
107	Military Personnel Management
108	Reserve Components: Organization, Roles, and Issues
110	Force Management
111	Human Resources Management for Strategic Leaders
112	Medical Services - A Force Multiplier for Strategic Leaders
114	Military Assistance to Civil Authorities
115	Managing Organizational Change
117	Strategic Planning and Management

119	The Strategic Environment and World Religions
120	Classical Military Strategy: Readings in Thucydides' History of the Peloponnesian War
122	Creative Thinking
123	Critical Thinking
124	Military and the Media
130	Health and Fitness Challenges of Future Military Operations
140	Readings on Strategic Leadership
150	Leader Adaptability
160	Ethics and Warfare
181	**Emerging Technologies for Strategic Leaders**

Table 4.9. Department of Military Strategy, Plans and Operations (DMSPO) Electives.

301	Theater Strategy and Campaign Planning
302	Army's Partners: Air Force, Navy and Marine Corps
304	**Information Operations: Doctrine, Organizations, and Capabilities**
307	Expeditionary Warfare
309	**Military Space Operations**
310	Unconventional Warfare
311	Special Operations
314	Airpower and Modern Warfare
317	Joint Force Land Component Command Operations
318	Joint Force Air Component Commander
319	Case Studies in Center of Gravity Determination
600	Warfighting Studies Program

4.5 CSA Professional Reading Program.

The Chief of Staff of the Army (CSA) has designated a professional reading list as a list for leaders – and has defined it as a pillar for leadership development.[73] The books included in this list are designed to provoke critical thinking concerning the profession of arms, soldiering, and the unique role of landpower. This professional reading list is arranged within broad general categories according to grade.

ARMY HERITAGE AND MILITARY HISTORY FOR CADETS, SOLDIERS, AND JUNIOR NCOS.

1. Ambrose, Stephen, *Band of Brothers*.
2. Atkinson, Rick, *The Long Gray Line*.
3. Brokaw, Tom, *The Greatest Generation*.
4. Fehrenbach, T.R., *This Kind of War*.
5. Heller, Charles E. and Stofft, William A., *America's First Battles*.
6. Hogan, David W., Jr., *225 Years of Service, The U.S. Army 1775-2000*.
7. Keegan, John, *The Face of Battle*.
8. Moore, Harold and Galloway, Joe, *We Were Soldiers Once and Young*.
9. Myer, Anton, *Once and Eagle*.
10. Shaara, Michael, *The Killer Angels*.

ARMY HERITAGE AND MILITARY HISTORY FOR COMPANY GRADE OFFICERS, WO1-CW3, AND COMPANY CADRE NCOS.

1. Ambrose, Stephen, *Citizen Soldiers*.
2. Coffman, Edward, *The War to End All Wars*.
3. Huntington, Samuel P., *The Soldier and the State*.
4. Linderman, Gerald F., *Embattled Courage: The Experience of Combat in the American Civil War*.
5. MacDonald, Charles B., *Company Commander*.
6. Marshall, S.L.A., *Men Against Fire: The Problem of Battle Command in Future War*.
7. Millett, Allan R., and Maslowski, Peter, *For the Common Defense*.
8. Scales, Robert H., Jr., *Certain Victory*.
9. Stoler, Mark A., *General George C. Marshall: Soldier-Statesman and the American Century*.
10. Willard, Tom, *Buffalo Soldiers (Black Saber Chronicles)*.

ARMY HERITAGE AND MILITARY HISTORY FOR FIELD GRADE OFFICERS, CW4-CW5, AND SENIOR NCOS.

1. Appleman, Roy, *East of Chosin*.
2. Cosmas, Graham, *An Army for Empire*.
3. Doughty, Robert, *The Evolution of U.S. Tactical Doctrine, 1946-76*.
4. Jomini, Antoine Henri, *Jomini and His Summary of the Art of War*.
5. MacDonald, Charles B., *Three Battles: Arnaville, Altuzzo, and Schmidt*.
6. McPherson, James, *Battle Cry of Freedom*.
7. Nye, Roger H., *The Challenge of Command*.
8. Palmer, Dave, *Summons of the Trumpet*.
9. Van Creveld, Martin, *Supplying War*.
10. Weigley, Russell F., *The American Way of War*.

ARMY HERITAGE AND MILITARY HISTORY FOR SENIOR LEADERS ABOVE BRIGADE.

1. Clausewitz, Carl von, *On War*, Ed. By Paret and Howard.
2. Greenfield, Kent, *Command Decisions*.
3. Howard, Michael, *War in European History*.
4. Kennedy, Paul, *The Rise and Fall of Great Powers*.
5. Kissinger, Henry, *Diplomacy*.
6. Murray, Williamson and Millett, Alan R., *Military Innovation in the Interwar Period*.
7. Neustadt and May, *Thinking in Time*.
8. Paret, Peter, *Makers of Modern Strategy*.
9. Skelton, William, *An American Profession of Arms*.
10. Summers, Harry, *On Strategy*.
11. Thucydides, *The Peloponnesian War*.

Chapter 5. The Navy Professional Military Education System and Technical Education.

The Navy PME system, like that of the Army, provides for the development of officers throughout their career. The instruction in the PME system is progressive and sequential and builds upon the skills, knowledge, and experience acquired through previous training and operational assignments. In contrast to the Army, the Navy officer PME system is much more specialized within each of the specific warfare communities. The warfare communities within the Navy can be broadly categorized as Surface Warfare, Submarine (Undersea) Warfare, Aviation, and Fleet Support and Supply. Overlaid throughout an officer's career are professional reading, correspondence courses, distance learning and professional development that take place at the unit level.

Recently, the Navy has instituted a new program called Command Leadership Continuum.[74] The Navy Leadership Continuum is a career-long continuum of Navy leader development, from recruitment to retirement. A total of 8 Leadership Training Courses for officer and enlisted personnel have been developed to form the cornerstone of that continuum. These progressive and sequential courses are all 2 weeks in length with the exception of the 9-week senior enlisted academy. Four major themes are the foundation of all the courses: values; responsibility, authority, and accountability of leadership; unity of command, Navy and services and risk management/ continuous improvement. The 4 officer courses are Basic (division officer/branch officer), Intermediate (department head/aviation 2nd sea tour), Advanced (XO/aviation department head), Command (CO/aviation XO). Officers generally attend these courses in conjunction with other PME courses.

Within each of the warfare communities, the College of Naval Command and Staff and the College of Naval Warfare represent common PME courses. Similarly, the Navy Professional Reading Program is common to all Naval officers. Consequently, the description of these courses and the professional reading program will be provided once, under Surface Warfare Officer PME and not repeated for the other warfare communities.

5.1 Surface Warfare Officer PME.

The Navy PME system within the Surface Warfare community is graphically represented in Figure 5.1. As officers progress in rank and experience, they return for progressive PME courses, predominately at the Surface Warfare Officer School in Newport, RI.

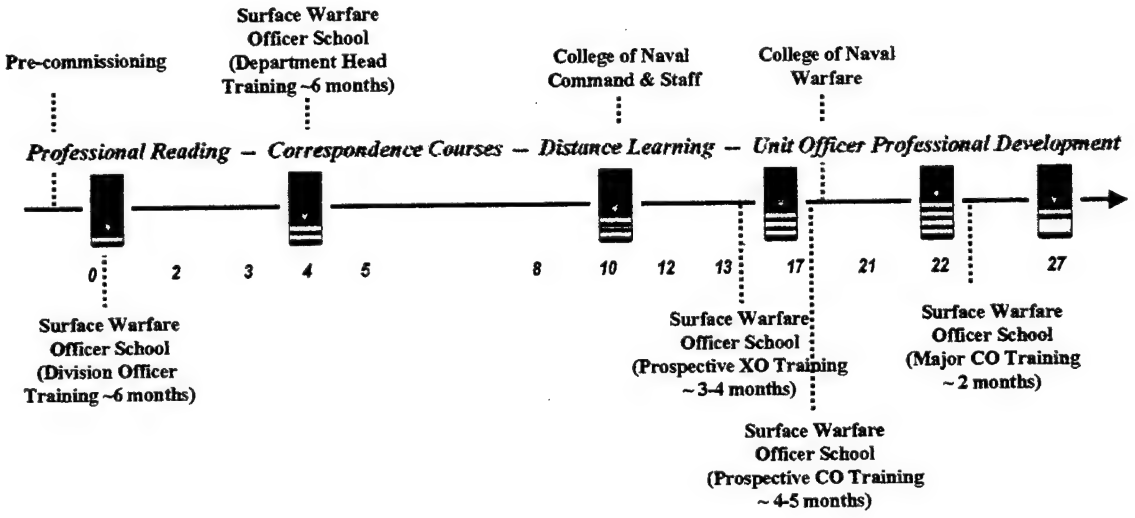

Figure 5.1. Navy PME System for Surface Warfare Officers.

5.1.1 Division Officer Training.

This school prepares newly commissioned Ensigns, enroute to their first tour as division officers afloat, to stand inport and underway watch, and manage the administrative duties of the division officer afloat. Division Officer Training[75] is conducted at the Surface Warfare Officer School in Newport, RI and is approximately 6-months in length. This course is comprised of Core Phase 1 and Core Phase 2 courses. Core Phase 1 is 11-weeks in length and covers operations and combat systems fundamentals.

Table 5.1 Core Phase 1.

Rules of the Road	Navigation
Underway Watch Organization and Administration	Seamanship
Shiphandling	Message Writing
Maneuvering Boards	Training and Readiness
Simulations	Damage Control
Leadership	Officer of the Deck Inport

Core Phase 2 is 6-weeks in length and covers platform specific engineering training. The specialty training programs offered during this phase of the course include:

Steam (and Nuclear) Engineering (Code 62)

- Unit 1: Core Theory Lessons
- Unit 2: Main Propulsion Lessons
- Unit 3: Auxiliary Systems Lessons
- Unit 4: Management Operations Lessons

Diesel Engineering (Code 63)

Gas Turbine Engineering (Code 64)

Boiler Water/Feedwater (Code 65)

The Core Theory Lessons from Code 62 are shown in Table 5.2.

Table 5.2 Core Phase 2 Theory Lessons.

60B-101	Basic Thermodynamics
60B-102	Basic Steam Cycle/Boilers
60B-103	Internal Combustion Engine Theory
60B-104	Basic Gas Turbine Engine Theory
60B-105	Pumps and Hydraulics Theory
60B-106	Materials, Corrosion, and Cathodic Protection
60B-107	Piping, Valves and Gages
60B-108	Fans and Ventilation
60B-109	Electrical Fundamentals/Basic Magnetism
60B-110	Inductance and Capacitance
60B-111	AC Theory and Electrical Generation
60B-112	Motors and Controllers

5.1.2 Department Head Training.

This school prepares mid-grade Surface Warfare Officers to confidently and competently manage departments and direct underway operations. Department Head Training[76] is conducted at the Surface Warfare Officer School in Newport, RI and is approximately 6-months in length. The core curriculum consists of 3 phases with the subject coverage shown in Table 5.3.

Table 5.3. Department Head Training Core Curriculum.

I. Combat Systems	II. Engineering Fundamentals
C4ISR Warfare	Core Engineering Fundamentals
Expeditionary Warfare	Material Science
Undersea Warfare	Electrical Fundamentals
Surface Warfare	Mechanical Fundamentals
Air Defense	Quality Assurance
	Steam Engineering Platform
	Diesel Engineering Platform
	Gas Turbine Engineering Platform
	III. Damage Control Fundamentals

A specialty curriculum follows the core curriculum, which focuses on billet specific and platform specific training. The last portion of Department Head Training is Shipboard Readiness Training, which provides students with afloat safety and leadership training.

5.1.3 College of Naval Command and Staff.

In the College of Naval Command and Staff[77] students pursue studies in three core subject areas in the following order of presentation: Strategy and Policy, Joint Maritime Operations, and National Security Decision Making. While this basic curriculum is essentially the same as that taught to the more senior students enrolled in the College of Naval Warfare, individual courses are tailored to the experience level and career needs of the College of Naval Command and Staffs mid-grade officers. Another minor distinction is that the Department of Joint Military Operations focuses on joint *maritime* operations rather than joint *military* operations.

The curriculum common to both the College of Naval Command and Staff and the College of Naval Warfare is described in the following section.

5.1.4 College of Naval Warfare.

The College of Naval Warfare is the Senior Service College of the Navy. It is a 10-month program with a curriculum[78] based upon 3 core courses of study in the order of presentation: National Security Decision Making, Strategy and Policy, and Joint Military Operations, in addition to a multidisciplinary Electives Program.

5.1.4.1 National Security Decision Making.

National Security Decision Making (NSDM) is a 13-week course of study that stresses the growing complexity of decision-making at higher levels of responsibility and authority. NSDM is divided into 3 major courses, which are taught in parallel during the trimester:

- Strategy and Force Planning (SFP) Course (36 Sessions).
- Resource Allocation Course (EDM) (23 Sessions).
- Policy Making and Implementation (PMI) Course (27 Sessions).

5.1.4.1.1 Strategy and Force Planning (SFP). The Strategy and Force Planning course consists of three main parts: Strategic Planning, Geostrategic Planning, and Military Strategy and Force Planning. Strategic Planning, focuses on U.S. grand strategy, particularly its economic and political, or diplomatic, components. Geostrategic Planning focuses on an examination of geostrategic issues that defense planners must consider. Military Strategy ad Force Planning focuses specifically on the military component of grand strategy: military strategy and the forces required to support that strategy. Table 5.4 identifies the lessons in the Strategy and Force Planning course.

Table 5.4. Strategy and Force Planning Lessons.

Introduction to Strategy and Force Planning	**RMAs, Technology and Future Warfare**
Contending Analytical Perspectives	Strategy and Force Alternatives
National Interests and Strategic Uncertainties	**Air Planning Challenges**
Thinking About Security	**Land Planning Challenges**
Neo-Isolationism Versus Primacy	**Maritime Planning Challenges I**
Cooperative Security	**Maritime Planning Challenges II**
Selective Engagement	**Nuclear, Biological, and Chemical Planning Challenges**
Economics and National Security	**C4ISR Planning Challenges**
International Economic Strategies	**Space Planning Challenges**
Diplomacy	**Planning the Military After Next**

Alliances, International Institutions	SFP Exercise I
Arms Control	SFP Exercise II
Competing Geostrategic Perspectives	SFP Exercise III
Asia and the Pacific	SFP Exercise IV
Greater Near East	SFP Exercise V
Greater Europe	SFP Exercise VI
Approaches to Force Planning	Review & Reflection
The Future of War	Final Exam

Lessons in bold indicate those dealing with technological implications on strategy and force planning.

5.1.4.1.2 Executive Decision Making (EDM). Executive Decision Making focuses on improving the student's decision-making capability. The EDM course treats high-level defense decision-making as a critical skill based primarily on an individual's professional knowledge, judgment, and clear and logical thinking. The course is divided into two parts: the first part addresses the formal resource allocation process. The second part develops the executive decision-making approach and applies it to current defense problems.

Table 5.5. Executive Decision Making Lessons.

Introduction to Resource Allocation	Analysis Concepts: Uncertainty and Risk
The Defense Resource Allocation Process: Lecture	Analysis Concepts: Combining Criteria
The Joint Strategic Planning System	Analysis Concepts: Modeling
The Planning, Programming, and Budgeting System	Evaluating Analysis
The Acquisition Process	Force-on-Force Analysis
The Federal Budget	Policy Analysis
The Defense Resource Allocation Process: Synthesis	Decision Theory
Overview of the Executive Decision Making Framework	Decision Exercise
The Definition Phase	Reconciliation Principles
Analysis Concepts: Effectiveness	Public Dispute Resolution
Analysis Concepts: Cost	Negotiation Exercise
	Course Synthesis

5.1.4.1.3 Policy Making and Implementation. The Policy Making and Implementation (PMI) course is designed to increase the students' understanding of the political, organizational and behavioral phenomena that are relevant to national security decision-making at the national level, at major headquarters units, and joint operational commands. This understanding is intended to increase the students' future professional competence as a senior-level participant in the national security community.

Table 5.6. Policy Making and Implementation Lessons

Introduction to PMI	Leading Large Organizations
Introductory Case Study: "Lebanon Revisited"	Strategic Leadership Simulation
Perspectives on Decision Making	Personality Type Preference: The MBTI
The International Political System	The Individual and Credibility
Case Study: IPS: The Landmines	A Case Study in Leadership
Congress, Interest Groups, and National Security	Assessment and Future Direction
Public Opinion and the News Media	Case Study: the National Security Agency
The President, NSC, and Rational Perspective	**Implementing Change**
Organizational Impact on Security	Case Study: CNO and OPNAV Reorganization
Governmental-Politics; Power and Influence	Control, Evaluate and Reassess
Cognitive Factors in Decision Making	Case Study: The Corps Commander
Current Policy Analysis	Applications of Strategic Leadership
Review Case Study	Review Case Study
PMI Midterm Examination	PMI Final Exam

Lessons in bold contain material dealing with technological implications and organizational change.

5.1.4.2 Strategy and Policy.

Strategy and Policy is designed to teach students to think strategically. The theory and application of warfare from the time of Athenian sea power through the present are studied and a set of strategic themes are considered. The course draws upon the academic disciplines of history, political science, and international relations. Military factors, such as doctrine, *technological change*, and logistics, are also considered. The curriculum integrates these into a coherent approach to the study of war by providing a conceptual frame of reference, which

can be used to analyze complex political and military situations and formulate military strategies to address them. Table 5.7 shows the lessons in the Strategy and Policy course.

Table 5.7. Strategy and Policy Lessons.

Policy and War	**Second World War: The Interwar Period**
Classical Prototype: Athens & Sparta	Second World War: Grand Alliance
American Revolution & Maritime Theory	Chinese Civil War: Maoist Theory
Napoleonic Era: Europe 1792-1815	Korean War: Containment
The Wars of German Unification	Vietnam War: Limited Revolutionary War
The Russo-Japanese War	The Gulf War
First World War: Total War and Strategic Assessment	Retrospect and Prospect

Lessons in bold contain material dealing with technological innovation and organizational change.

5.1.4.3 Joint Military Operations.

Joint Military Operations courses focus on the planning and conduct of joint and combined military operations in support of national and alliance strategic goals. Operational planning processes and concepts are stressed in the employment of military forces across the full spectrum of conflict. The operational level of war is examined through the use of real-world case studies and war gaming.

5.1.4.4 Naval War College Elective Program.

The core curriculum is enriched by an Electives Program offering a wide range of courses taught by the resident faculty and staff. Elective subjects range from military theory to area studies, from international relations to professional ethics, and from international law to media relations.

Table 5.8. Naval War College Electives Program

Intelligence for the Commander	The Persian Gulf, the U.S. and the Future
Intelligence and U.S. Military Operations	US Foreign Policy in the 20th Century
The CIA: Organization, Functions and Capabilities	Russian History After the Cold War
Counterintelligence	Southeast Asia and US Security
Expeditionary Warfare	Eastern Europe – The Balkans
Battle Command	International Relations: Theory & Practice
The Employment of Special Operations Forces	The American Revolutionary War and the Colonial Military Tradition
Seminar on Space Technology and Policy	The American Civil War
Lessons in Operational Warfighting	Patton's Peers: The Forgotten Army Commanders of the Western Front
The History of Technology	**Future War: Past and Present**
Proliferation of Weapons of Mass Destruction	World War II in the Atlantic and Europe
Maritime Security and Ocean Policy	World War II in the Pacific Theater
The US Merchant Marine: Its Role in National Defense and Economic Security	Winston Churchill: Statesman and War Leader
Navy Operations Elective	Vietnam – The Long War
Meteorologic and Oceanographic Factors in Military Operations	Colonial Wars: 1846-1902
Technology and Security	Faith and Force: Religion, War and Peace
Operational Warfare at Sea	The Age of Sail
Masters of War: Thucydides	Abraham Lincoln: Democratic Statesmanship in War and Peace
NATO – Cold War Successes to Strategic Incoherence?	George Washington: An Overview of His Life, Character, and Legacy
A Critical Analysis of Airpower Since WWI	Media and Politics
Aerospace Power Theory and Joint Air Operations	Generations in Film
Theories of Victory	Military and the Media: A Practitioner's Perspective
Sun Tzu's The Art of War	Executive Communication
Culture, Geography, and Former Yugoslavia	Foundations in Moral Obligation: The Stockdale Course
Strategy and Military Geography	Ethics and the Military
U.S. Civil Military Relations	Directed Research
A Ship's a Fool to Fight a Fort: Littoral Warfare Through the Ages	**Horizontal Integration: Enabling Network Centric Operations - Directed Research**
The Evolution of Fortifications & Siege Warfare	Naval Operational Planner Electives
Domestic and International Disaster Relief	**Wargaming Theory and Practice**
Logistics Management	Military Operations in Urban Terrain
Data Management and Applications	Modern China
Issues in International Economics	**Leading Innovation**
Financial Planning for the Military Executive	Imperial Russia
Military Justice and Administrative Law for the Commander	**Critical Thinking**
Rules of Engagement	National Security Policies of Middle Eastern States
The Constitution and National Security	Issues in Central and South Asian Security
Legal Issues in the War on Terrorism	**Information Technology in Warfare**

5.1.5 Prospective XO and CO Training.

The Prospective Executive Officer (XO) and Commanding Officer (CO) Training Courses prepare officers selected for XO and CO tours for the responsibilities of their new assignments. The PXO Training Course is 6-weeks in duration and is conducted at the Surface Warfare Officer School in Newport, RI. The curriculum consists of 233 hours covering the following subjects:[79]

- 84 hours Shipboard Management
- 48 hours Fighting the Ship
- 10 hours **Information Technologies**
- 53 hours Material Readiness
- 35 hours Mariner Skills

The PCO Training Course is an 8-week course also conducted at the Surface Warfare Officer School in Newport, RI and consists of a 320 hour curriculum covering:[80]

- 36 hours Shipboard Management
- 79 hours Fighting the Ship
- 32 hours Command Perspective
- 27 hours Mariners Skills
- 11 hours **Information Technologies**
- 105 hours Material Readiness
- 28 hours Ship specific Combat Systems Training

5.1.6 CNO Professional Reading Program.

The Navy, like the other Services, also has a professional reading program. The Chief of Naval Operations (CNO) Professional Reading Program[81] is comprised of books arranged in Basic, Intermediate, and Advanced Programs.

Basic Program.

1. *All Quiet on the Western Front*, Erich M. Remarque
2. *American Caesar: Douglas MacArthur 1880-1964*, William Manchester
3. *Brief History of Time: From the Big Bang to Black Holes*, Stephen M. Hawking
4. *Command of the Seas: A Personal Story*, John F. Lehman
5. *Everything We Had: An Oral History of the Vietnam War*, Al Santoli, ed.
6. *Flight of the Intruder*, Stephen Coontz
7. *Hunt for Red October*, Tom Clancy
8. *In Love and War*, James B. and Sybil Stockdale
9. *In Search of Excellence*, Thomas J. Peters
10. *On Watch*, Elmo Zumwalt
11. *Red Badge of Courage*, Stephen Crane
12. *Red Storm Rising*, Tom Clancy
13. *Run Silent, Run Deep*, Edward L. Beach
14. *The Caine Mutiny*, Herman Wouk
15. *The Cruel Sea*, Nicholas Monsarrat
16. *The Killer Angels*, Michael Shaara
17. *The Right Stuff*, Tom Wolfe
18. *The Russians*, Hedrick Smith
19. *The Sand Pebbles*, Richard Mckenna
20. *The Source*, James A. Michener
21. *The United States Navy: A Two Hundred Year History*, Edward L. Beach
22. *Two-Ocean War*, Samuel E. Morison
23. *War and Remembrance*, Herman Wouk
24. *Winds of War*, Herman Wouk

Intermediate Program.

1. *A Bright Shining Lie: John Paul Vann and America in Vietnam*, Neil Sheehan
2. *Admiral Arleigh Burke: A Biography*, E.B. Potter
3. *At Dawn We Slept: Untold Story of Pearl Harbor*, Gordon W. Prange
4. *Assignment-Pentagon*, Perry M. Smith
5. *Bull Halsey: A Biography*, E.B. Potter
6. *Commander in Chief: Franklin Delano Roosevelt His Lieutenants and their War*, Eric Larrabee
7. *Chrysanthemum and the Sword: Patterns of Japanese Culture*, Ruth Benedict
8. *Eagle Against the Sun: An American War with Japan*, Ronald H. Spector
9. *Eisenhower: At War, 1943-1945*, David Eisenhower
10. *Fate is the Hunter*, Ernest K. Gann
11. *First to Fight: An Island View of the U.S. Marine Corps*, Victor H. Krulak
12. *From Hiroshima to Glasnost*, Paul Nitze

13. *Kaizen: The Key to, Japan's Competitive Success*, Masaaki Imai
14. *Makers of Modern Strategy*, Peter Paret
15. *Master of Seapower: A Biography of a Fleet Admiral*, Thomas Buell and Ernest J. King
16. *Miracle at Midway*, Gordon W. Prange
17. *Modern Times: The World From the Twenties to the Eighties*, Paul Johnson
18. *Mountbatten*, Philip Ziegler
19. *Nelson, The Biography*, David Walder
20. *Nimitz*, E.B. Potter
21. *Out of the Crisis*, W. Edwards Deming
22. *Presidential Management of National Security*, Carnes Lord
23. *The Deming Management Method*, Mary Walton
24. *The Guns of August*, Barbara W. Tuchman
25. *The Maritime Strategy, Geopolitics and the Defense of the West*, Colin S. Gray
26. *The Mask of Command*, John Keegan
27. *The Pentagon and the Art of War*, Edward L. Luttwak
28. *The Quiet Warrior*, Thomas Buell
29. *Today's Isms: Communism, Fascism, Capitalism and Socialism*, William Ebenstien and Edwin Fogelman
30. *Sea Power: A Navy History*, E.B. Potter and Chester Nimitz
31. *Silent Victory: The U.S. Submarine War Against Japan*, Blair, Clay, Lippencott
32. *The American Way of War*, Russell F. Weigley
33. *The Atlantic Campaign: WW II Great Struggle at Sea*, Dan VanDerVat
34. *The Picture of Sea Power*, Eric L. Grove
35. *The KGB Today: The Hidden Land*, John Barron
36. *The Face of Battle*, John Keegan
37. *The Last Lion: Visions of Glory, 1874-1932*, William Manchester
38. *The Last Lion: Alone 1932-40*, William Manchester
39. *The Price of Admiralty*, John Keegan
40. *The Rise of American Naval Forces 1776-1918*, Harold and Margaret Sprout
41. *The Rivals: America and Russia since WW II*, Adam B. Ulam
42. *The Second World War*, John Keegan
43. *The U.S. and the Origins of the Cold War*, John L. Gaddis
44. *Vietnam: A History*, Stanley Karnow

Advanced Program.

1. *America at Century's End*, James L. Schlesinger
2. *Cold Dawn: The Story of SALT*, John Newhouse
3. *Democracy in America*, Alexis de Toqueville
4. *Deterrence in American Foreign Policy: Theory and Practice*, Alexander George
5. *Fleet Tactics: Theory and Practice*, Wayne P. Hughes
6. *From Beirut to Jerusalem*, Thomas L Friedman
7. *How Democracies Perish*, Jean-Francois Revel
8. *Man, the State and War: A Theoretical Analysis*, Kenneth N. Waltz
9. *Military Strategy: A Naval Theory of Power Control*, Joseph C. Wylie
10. *Origins of the Maritime Strategy: American Naval Strategy in the First Postwar Decade*, Michael A. Palmer
11. *On War*, Carl Von Clausewitz,
12. *Power and Change: The Administrative History of the Office of the CNO*, Thomas C. Home
13. *Seapower and Strategy*, Colin S. Gray and Roger Barnett
14. *Some Principles of Maritime Strategy*, Julian S. Corbett
15. *Strategy for Defeat: Vietnam in Retrospect*, U.S. Grant Sharp
16. *Strategy: The Logic of War and Peace*, Edward N. Luttwak
17. *The Art of War*, Sun Tzu
18. *The Geopolitics of Superpowers*, Colin S. Gray
19. *The Influence of Sea Power upon History*, Alfred T. Mahan
20. *The Soldier and the State: The Theory and Politics of Civil-Military Relations*, Samuel P. Huntington
21. *The White House Years*, Henry Kissinger
22. *The U.S. Navy: The View from the Mid 1990's*, James L. George
23. *The Ultra Secret*, F.W. Winterbotham
24. *U.S. Defense Policy in an era of Constrained Resources*, Robert L. Pfaltzgraff, Jr. and Richard H. Shultz, Jr.
25. *Resources War and Politics*, Bernard Brodie

5.2 Submarine Warfare Officer PME.

The Navy PME system within the Submarine Warfare community is graphically represented in Figure 5.2. As officers progress in rank and experience, they return for progressive PME courses, predominately at the Submarine Warfare Officer School in Groton, CT. Overlaid throughout an officer's career are professional reading, correspondence courses, distance learning and professional development that take place at the unit level.

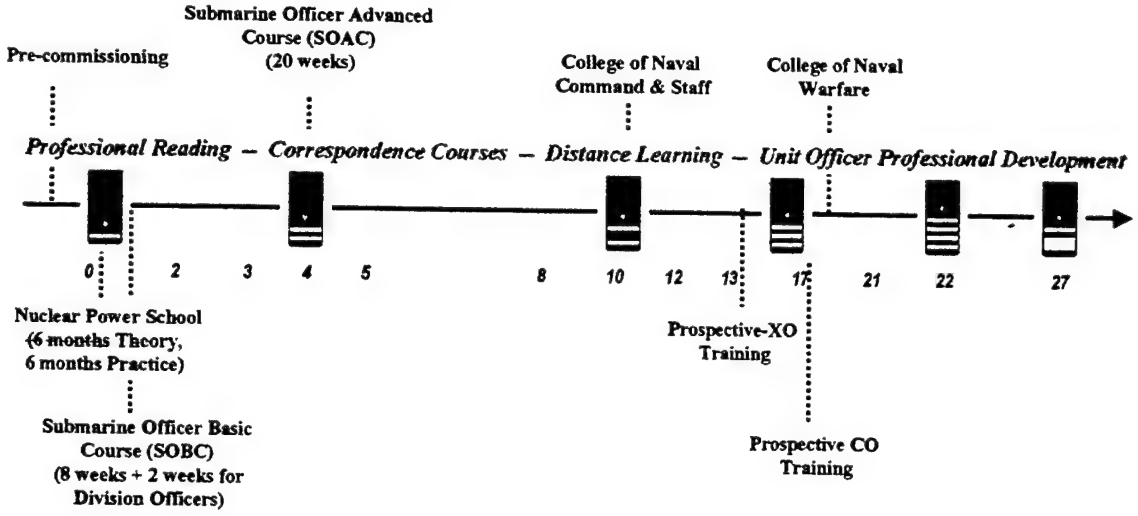

Figure 5.2. Navy PME System for Submarine Warfare Officers.

5.2.1 Nuclear Power School.

Nuclear Power School[82] is conducted at the Naval Nuclear Power Training Command (NNPTC) in Charleston, South Carolina. This course lasts approximately 6 months and provides students a broad background on the theory and operational mechanics of a Naval nuclear propulsion plant. Nuclear Power School subjects include Mathematics (51

hours), Physics (78 hours), Chemistry (48 hours), Thermodynamics (88 hours), Electrical Engineering (137 hours), Materials (34 hours), Reactor Dynamics and Core Characteristics (86 hours), Reactor Plant Systems (11 hours), Shielding and Radiological Fundamentals (43 hours), and Aspects of Reactor Plant Operations (110 hours). The 6-month Nuclear Power School is followed by an additional 6-months of training at a Nuclear Power Training Unit (NPTU), in either New York or South Carolina. Training at NPTU includes working on an actual operating reactor. The first month at NPTU is spent studying the systems and components of a particular nuclear propulsion plant. The remaining 5 months of training is in a full-scale operation plant with all of its associated systems.

5.2.2 Submarine Officer Basic Course.

The Submarine Officer Basic Course[83] (SOBC) is a 13-week standard indoctrination course taken by all navy officers who volunteer for submarine duty. It is conducted at the Naval Submarine Base, Groton, CT.

During indoctrination, the prospective submariner learns early that a complete and comprehensive knowledge of submarines is needed to qualify as a submariner. This includes learning the principles of maneuvering a nuclear submarine and the operation of its basic systems and equipment; duties of the officer of the deck; in-port responsibilities, ship-board organization; damage control; security and classified material responsibilities; watchstanding and division officer responsibilities.

Additionally, the students learn submarine safety systems relating to oxygen, ventilation, electrical batteries, plumbing, hydraulic, high-pressure air, and seamanship.

They also are prepared for the administrative duties they will perform as division officers and become imbued with a deep sense of responsibility for the knowledge, competence and dependability required in the performance of their duties aboard a submarine.

5.2.3 Submarine Officer Advanced Course.

Submarine Officer Advanced Course[84] is a 20-week curriculum for those submarine qualified officers who will be returning to sea for their first submarine department head position. The SOAC curriculum contains similar subject coverage as that found at SOBC but with a focus on higher-level responsibilities.

5.2.4 Prospective XO and CO Training.

Like Prospective XO and CO Training in the other warfare communities, these courses prepare officers to assume the duties of XO and CO aboard U.S. submarines.

5.3 Aviation Officer PME.

The Navy PME system within the Aviation community[85] is graphically represented in Figure 5.3. The predominate Navy school in an aviator's career progression is Flight Training that occurs at Pensacola, Florida. Overlaid throughout an officer's career are professional reading, correspondence courses, distance learning and professional development that take place at the unit level.

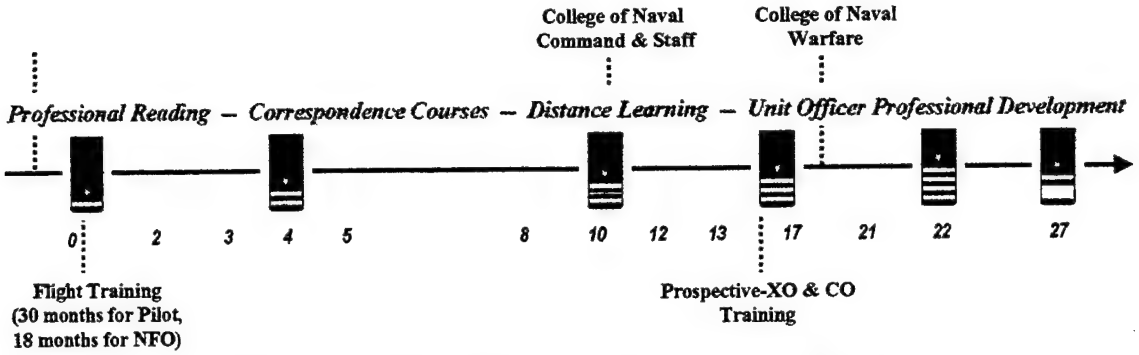

Figure 5.3. Navy PME System for Aviation Officers.

5.3.1 Flight Training.

Flight training is specialized training that provides officers with the technical knowledge and skills necessary to be Pilots and Naval Flight Officers (NFOs). Flight training begins with a Preflight program, which develops both mental skills and physical abilities. Classes include engineering, aerodynamics, air navigation, flight rules and regulations, aviation physiology, and water survival. Intermediate flight training is platform specific. While common skills such as navigation and air traffic control are covered, intermediate training for single seat aircraft focus on individual skills while multi-seat platforms focus on crew coordination. Advanced Flight Training is the final stage in flight training. Here students learn skills specific to a chosen platform such as air-to-air combat, bombing, search and rescue, aircraft carrier qualifications, over water navigation, and low level flying.

5.3.2 Prospective XO and CO Training.

Like Prospective XO and CO Training in the other warfare communities, these courses prepare officers to assume the duties of XO and CO in the aviation warfare community.

5.4 Fleet Support and Supply Officer PME.

The Fleet Support and Supply Community represents specialties within the Navy dedicated to supporting the fleet. Included in this population of Naval officers are Restricted Line (RL), Staff Corps, and Limited Duty (LD) officers. RL specialties include but are not limited to Intelligence, Engineering Duty, Cryptology, Public Affairs, and Human Resources officers. The Staff Corps include Medical, Supply, Chaplain, and Judge Advocate General specialties.

Because officers in this broad, general warfare community each follow specialized training that is not representative of the broader Navy PME system, they will not be included in this analysis. The majority of the officers in this warfare community, however, receive an advanced graduate education and hold advanced degrees applicable to their specialties.

Chapter 6. The Air Force Professional Military Education System and Technical Education.

The Air Force PME system, like that of the Army and Navy, provides for the development of officers throughout their career. The instruction in the PME system is progressive and sequential and builds upon the skills, knowledge, and experience acquired through previous training and operational assignments. While similar to the Army, the Air Force officer PME schools at the lieutenant and captain grade are much shorter in length than those in the Army. Overlaid throughout an officer's career are again professional reading, correspondence courses, distance learning and professional development that take place at the unit level.

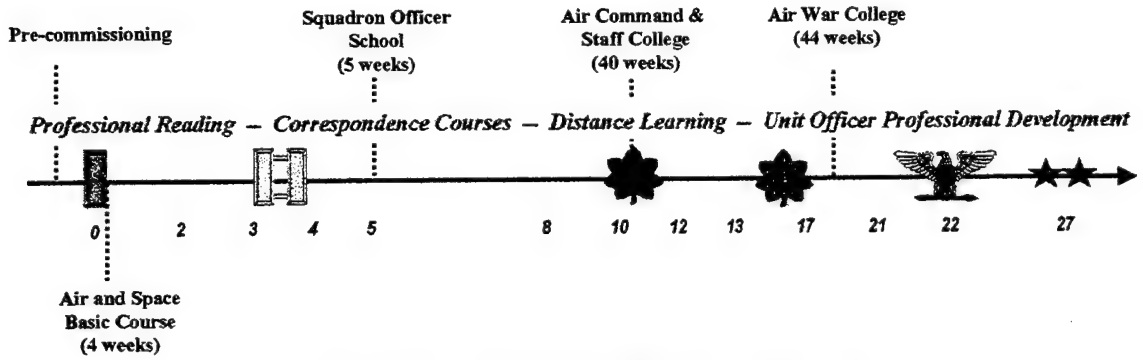

Figure 6.1. Air Force Officer PME System.

6.1 Air and Space Basic Course.

This course is the first course in the Air Force officer PME system. For newly commissioned lieutenants, the 4-week course includes[86] modules of study ranging from core competencies and aerospace power employment to operations planning. The course is designed for students to understand their role as airmen and how all the career fields work together to

create aerospace power as well as how the Air Force as a service fits with the country's other armed forces.

6.2 Squadron Officer School

The mission of Squadron Officer School,[87] the second Air Force officer PME course, is to develop dynamic leaders rededicated to the profession of arms. For captains with 4-7 years experience, this 5-week course emphasizes officer application, leadership tools, and air and space power.

6.3 Air Command and Staff College.

The Air Force Air Command and Staff College is a 40-week curriculum [88]that focuses on educating students on the profession of arms, the history of air power, international security studies, the requisites of command, the nature of war, and the application of air and space power at the operational level of war. The college prepares officers to think critically and communicate effectively. The curriculum emphasizes warfare and campaign planning at the operational and strategic levels, and is composed of nine major courses of study as well as research or elective programs focused on the application of military power in the third dimension.

Table 6.1. Air Command and Staff College Core Courses.

Leadership and Communication Studies	8 semester hours
National and International Security Studies	3 semester hours
Nature of War	3 semester hours
Airpower Studies	3 semester hours
National Planning Systems	1.5 semester hours
Joint Forces	3 semester hours
Joint Campaign Planning	2.5 semester hours
Aerospace Operations	4 semester hours
Aerospace Execution Exercise	1 semester hours
Gathering of Eagles	0 semester hours
Research Education	3 semester hours

Table 6.2. Air Command and Staff College Elective Courses.

EL 5601	The War for Public Opinion: Propaganda, Public Affairs and the Military-Media.	EL 5640	Aircraft Production in the First World War.
EL 5610	Teams and Their Organizational Realities.	EL 5641	A History of Mutiny, Desertion and Insubordination.
EL 5620	Advanced Space Studies: Policy and Applications.	EL 5642	Revolutionary Innovation in Military Organizations.
EL 5621	Air Logistics: Key Enabler and Operational Art Element.	EL 5643	Small Wars and Counter-Insurgencies.
EL 5623	**Future Trends and Their Impact on the Military.**	EL 5644	The Air War Over Serbia: A Case Study in Airpower.
EL 5622	Air Mobility.	EL 5645	The American Way of War: The U.S. Army from Appomattox to DESERT STORM.
EL 5624	Intelligence Operations.	EL 5646	The Challenge of Command in the American Civil War.
EL 5625	Measuring Airpower Effectiveness.	EL 5648	A History of Airborne Operations.
EL 5626	Military and Commercial Uses of Space.	EL 5649	The Intellectual and Institutional Elements of Air Force Doctrine.
EL 5627	**Modeling, Simulation, & Wargaming-Theory and Practice.**	EL 5650	The Development of Airpower Thought and Practice.
EL 5628	Peace Operations and Peace Enforcement -- US and International Perspectives.	EL 5660	Causes and Prevention of War.
EL 5629	**Quantitative Tools for Military Operations.**	EL 5661	Dirty Politics: Dictators, Terrorists and Godfathers.
EL 5630	**The Impact of the Communications Revolution on Warfighting in the Future.**	EL 5662	Islam and Islamism: Radical Political Religion, Ideology and the State.
EL 5631	World Space Issues for International Officers.	EL 5663	Military Intervention in the Post-Cold War Era.
EL 5632	The Military Commander and the Law.	EL 5664	Weapons of Mass Destruction: Challenge and Response.
EL 5633	The Total Force: Yesterday, Today and Beyond.	EL 5665	The United States as a Great Power.

EL 5634	Morality and War: Implications for the War Fighter.	EL 5666	War and Society in 20th Century Central Europe.
EL 5635	War Between Equals.	EL 5690	A Gathering of Eagles (GOE).
EL 5636	**Strategy and Technology.**	EL 5691	Prairie Warrior.

6.4 Air War College.

The Air War College is the senior school in the Air Force PME system and is 44-weeks in length consisting of 31 credit hours of course work. It educates selected senior officers to lead at the strategic level in the employment of air and space forces. The curriculum[89] focuses on coalition warfighting and national security issues, with emphasis on the effective employment of aerospace forces in joint and combined combat operations.

The core curriculum consists of five major areas: future conflict studies; leadership and ethics; international security studies; strategy, doctrine, and airpower; and joint force employment, described in Table 6.3.

Table 6.3. Air War College Core Curriculum Courses.

DFC 6100, Future Conflict Studies	**3 semester hours**
Future Conflict Studies educates senior officers to lead at the strategic level in the employment of aerospace forces, including joint and combined operations, in support of national security with special emphasis on the **future-oriented challenges** on the emerging security environments. Identifies the strategic implications of future-oriented threats, especially those likely to be asymmetric to US experience and expectations. Examines the US national military strategy, **USAF research and development (R&D)** and future operational planning from the "Red Team" perspective, where possible, to permit agile, proactive and future-focused USAF strategic planning for air, space, and **information superiority**.	
DFL 6200, Leadership and Ethics	**3 semester hours**
Leadership and Ethics educates senior leaders to develop the vision, competencies, and ethics to lead in the strategic environment. The objective is to assist the student to transition from the direct tactical level of leadership (applying ethical standards and the leadership and management of individuals at the unit level, i.e., leadership by presence) to the indirect strategic levels of leadership (establishing and maintaining ethical standards while leading large units/organizations through subordinate commanders, i.e., leadership by principle).	

DFS 6300, International Security Studies	**4 semester hours**
International Security Studies analyzes the development and implementation of US national security, to include principles, practices, participants, and challenges. The purpose of the course is to educate senior officers on the development and implementation of national security strategy and policy. Building on principles and practices of US security policy, the course then shifts to cover US regional security issues and problems. This course links US national security to the political and economic conditions and events in Europe, Asia, Russia, Latin America, the Middle East, and Africa.	
DFS 6400, Strategy, Doctrine, and Airpower	**4 semester hours**
The Strategy, Doctrine, and Airpower Course instills in students an understanding of the roles of strategy, doctrine, and the employment of aerospace power in national security. The course builds on the following assumptions. First, strategy is based on time-tested principles. Second, strategy and doctrine are inextricably linked and an understanding of both is critical for the senior leader. Finally, wars test the validity of specific strategies and doctrines with important lessons for the leaders of today and tomorrow. With these assumptions in mind, the course uses history—particularly the history of air and space power—as a vehicle for developing an understanding of the employment of air and space forces in support of national security today and in the future.	
DFW 6500, Joint Force Employment	**6 semester hours**
Joint Force Employment prepares students to apply critical thinking when developing joint and multinational warfighting strategies, to understand the capabilities and doctrines of sister services, and to appreciate the role of aerospace power as a key component of joint warfare. To do this and provide the highest quality joint education available, the department addresses several areas: the application of the national military strategy in attaining national security objectives in peacetime and in war; the interrelationship of national and defense planning systems; theater-level operations focusing on leadership and employment of multiservice and multinational forces in joint and combined operations in war and military operations other than war; and understanding the integration of joint and service systems supporting military operations at the strategic level of war.	
RS 6600 Regional Studies	**5 semester hours**
The Regional Studies Program provides each student the opportunity to evaluate an area of the world where a regional unified commander in chief must implement national military strategy in support of US security policy. This implementation is considered in light of State Department regional strategy and expeditionary Air Force capabilities, along with other military options. The course allows AWC students to gain an inside perspective by visiting and studying a region for a 10- to 12-day period during the field studies portion of the course. Before discussing security policy issues with senior-level political, military, and academic leaders in other nations, each student will, during the third term, complete 30 classroom hours of focused academic preparation and begin work on a research paper dealing with regional security in the area. The research paper is completed following the field studies trip to permit inclusion of field observations in the student's analysis.	

Table 6.4. Air War College Elective Courses.

6418	American Leadership and the War of 1812	6215	Leadership Case Studies
6815	Advanced Counterproliferation Issues	6216	Leadership in the 21st Century
6416	Air Mobility	**6218**	**Leading Visionary Organizations**
6412	Air War in the Pacific	6311	American National Government
6415	Airpower Theory, Doctrine and Strategy, 1910–1945	1226	The Commander and the Law
6416	Airpower Theory, Doctrine and Strategy, 1945–Present	1523	Navy and Marine Corps Expeditionary Forces
1514	America's Army	**6133**	**NBC Threats and Counterproliferation Issues**

6417	American Civil War	6222	Psychology of Decision-Making
6210	Art of Command	6342	Russia and the Soviet Successor States
6313	Causes of War	6344	Russian/Soviet Military History
6115	**Chemical and Biological Warfare Issues for the USAF**		
6329	Intelligence	**6524**	**Space Fundamentals**
6211	Command and Conscience	**6525**	**Space Issues**
6116	Commandant's Professional Studies Paper		
6117	Commandant's Professional Studies Paper—Airpower	6529	Special Operations—Then and Now
6212	Core Values	**6447**	**Strategy and Technology I**
6113	Asian Conflicts and US Interests: Implications for the Future	**6448**	**Strategy and Technology II**
6122	Directed Study	6137	Substate Conflict
6123	Directed Study—Airpower	6139	Sun Tzu: Unconventional Strategic Thought
6472	Billy Mitchell's Air War: Practice, Promise, and Controversy in Early Military Aviation	6314	Civil War Soldier
6320	Emerging Southeast Asia	**6453**	**Technology and the History of Warfare**
1213	Executive Speaking	1517	Intelligence Support to Warfighting
6129	International Crime and National Security	6110	International Rivals: Leadership and Strategic Cultures in Countries and Groups of Concern
6226	Leadership and the AEF	6439	Military Biography
6441	National Security Planning: FDR to Present	6135	Ottoman Strategy and Modern Turkey
6225	Senior Leadership Survival Course	6526	Space Policy Issues
6470	Strategic Nuclear Issues and International Security	**6452**	**Surprise and Deception in Modern War**
6364	The Collapse of Yugoslavia	1225	The Commander and the Law
6345	The Future of Europe	6213	The Leader and Strategic Leadership
6346	The Politics of NATO	6466	War and Peace in the Balkans 1800–2000
6350	War in Colombia	**6531**	**Wargaming, Modeling, and Simulation for the Warfighter**
6119	WMD Counterforce Issues	6217	Leadership and World War I
1710	English as a Second Language	**6454**	**Technology and World War I**
6541	Character Development Education	6140	Terrorism
6432	Foundations of Modern Strategy	1226	The Commander and the News Media
6314	Chinese Military Affairs	6424	Clausewitz and His Critics
	Gulf War	**6521**	**Theaters of Future Conflict**
6516	History of Joint Warfare	**1530**	**Future Total Force Issues**
6328	History of Warfare in the Middle East	6458	US Defense Policy since 1945
6121	Cultures of Violence	6426	Directed Study in Strategic Thought
6331	Inter-American Security Issues	6349	US Grand Strategy
6130	International Flash Points	6460	USAF Senior Leadership: A Historical Approach
6332	International Organizations & Peacekeeping Ops	6461	Vietnam War 1945–1975
6134	**NRO Issues**	1462	Visual Media: Propaganda and Strategic Image

6518	Joint Force Air Component Commander (JFACC) Introduction	6531	War Gaming, Modeling, and Simulation for the War Fighter
6519	Joint Land, Aerospace, and Sea Simulation (JLASS) I	6322	Ethnicity and Nationalism
6520	JLASS II	6532	World Space Issues

6.5 CSAF Professional Reading Program.

General Ronald Fogleman created the Chief of Staff of the Air Force (CSAF) Professional Reading Program in 1996 to develop a common frame of reference among Air Force members to help each become better, more effective advocates of aerospace power. General Michael Ryan and now General John Jumper have embraced and continued the Professional Reading Program.[90] These books are intended to foster an understanding of the role and evolution of air and space power. The Air Force Professional Reading Program is divided by officer grade.

Basic Program (2Lt through Capt)

1. *10 Propositions Regarding Air Power*
2. *A Few Great Captains: The Men and Events That Shaped the Development of U.S. Air Power*
3. *Heart of the Storm: The Generals of the Air Campaign Against Iraq*
4. *Hostile Skies: A Combat History of the American Air Service in World War I*
5. *Lincoln on Leadership: Executive Strategies for Tough Times*
6. *The Right Stuff*
7. *This Kind of War: The Classic Korean War History*
8. *Thud Ridge*
9. *Winged Shield, Winged Sword: A History of the USAF*
10. *Winged Victory: The Army Air Forces in World War II*

Intermediate Program (Maj through LtCol)

1. *Makers of Modern Strategy: From Machiavelli to the Nuclear Age*
2. *Air Power: A Centennial Appraisal*
3. *General Kenney Reports: A Personal History of the Pacific War*
4. *Beyond Horizons: A Half Century of Air Force Space Leadership*
5. *The First Air War: 1914-1918*
6. *Over Lord: General Pete Quesada and the Triumph of Tactical Air Power in World War II*
7. *The United States Air Force in Korea*
8. *Rise of the Fighter General, 1945-1982: The Problem of Air Force Leadership*
9. *Storm Over Iraq: Air Power and the Gulf War*
10. *Hap Arnold and the evolution of American airpower*
11. *The US Air Force in Space: 1945 to the 21st Century*

Advanced (Col through Gen)

1. *Air Power Confronts an Unstable World*
2. *Courage and Air Warfare: Allied Aircrew Experience in the Second World War*
3. *Dereliction of Duty: Lyndon Johnson, Robert McNamara, The Joint Chiefs of Staff, and the Lies That Led to Vietnam*
4. *Ideas and Weapons*
5. *Flight of the Buffalo: Soaring to Excellence, Learning to Let Employees Lead*
6. *The Sky on Fire: The First Battle of Britain 1917-1918*
7. *Why the Allies Won [World War II]*
8. *... the Heavens and the Earth: A Political History of the Space Age*
9. *Hoyt S. Vandenberg: The Life of a General*
10. *Strategy for Defeat: Vietnam in Retrospect*
11. *Joint Air Operations: Pursuit of Unity in Command and Control, 1942-1991*
12. *On War*
13. *Airpower Against an Army: Challenge and Response in CENTAF's Duel with the Republican Guard*
14. *The Air Campaign [Desert Shield / Desert Storm]*

Chapter 7. The Marine Corps Professional Military Education System and Technical Education.

The Marine Corps has a well-established PME system that provides for the development of officers throughout their career. The instruction in the PME system is progressive and sequential and builds upon the skills, knowledge, and experience acquired through previous training and operational assignments. Officer education occurs in institutional training, in units, and through self-development.

The Marine Corps PME system is graphically represented in Figure 7.1. Here the major resident PME courses including the Basic School, Amphibious Warfare School, Command and Control Systems School, the Marine Corps Command and Staff College and the Marine Corps War College are shown. Overlaid throughout an officer's career are professional reading, correspondence courses, distance learning and professional development that take place at the unit level.

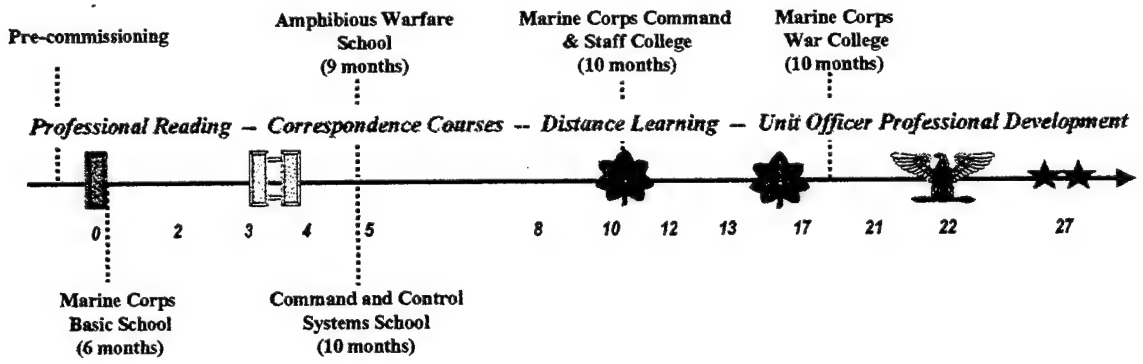

Figure 7.1. The Marine Corps PME System.

7.1 The Basic School.

The Marine Corps Basic School is a 6-month school for all newly commissioned lieutenants conducted at Quantico, Virginia. Its purpose is to provide newly commissioned officers with a basic professional education while instilling in them the esprit and leadership tradition of the Marine Corps. Additionally, this course provides a basic understanding of infantry skills to support ground combat operations and other infantry duties. The course is followed by specialty training and subsequent assignment to the Fleet Marine Force. The Basic School is composed of a series of different subject areas.[91]

LAND NAVIGATION. This subject is designed to enable the officer student to read maps and aerial photographs, use the compass, and navigate on land in daylight or at night

B1401	Introduction to Land Navigation and the Map
B1405	Direction
B1410	Terrain Analysis
B1415	Land Navigation: Tools and Techniques
B1435	Night Navigation I
B1450	Water, Vegetation, and Manmade Features
B1455	Location
B1485X	Land Navigation Final Exercise

COMMUNICATIONS. This subject is designed to introduce the officer student to Marine Corps communications at the small unit level with emphasis upon equipment, procedures and security measures.

B2501	**Introduction to Communications**
B2502	Radio Nets, Voice Radio Procedures, and Message Drafting
B2504	**Communication Security and Electronic Warfare**

Subjects in bold represent courses containing science and technology instruction

INTELLIGENCE. This subject is designed to provide the officer student with an understanding of combat intelligence agencies within the Marine Corps that support the intelligence mission and an introduction to the forces that may pose a threat to Marine Corps operating forces.

B0201	Intelligence in the Marine Corps

COMBAT SERVICE SUPPORT. Instruction in this subject is designed to enable the officer student to recognize the functions, structure and requirements for Combat Service Support in the Fleet Marine Force.

B0404	Leadership and the Responsible Officer
B0405.1	Introduction to Maintenance (Practical Application)

FIRST AID. Instruction in this subject is designed to teach the officer student the essential life saving steps, first aid procedures and evaluation and evacuation techniques necessary for first aid application in garrison or field environments.

B8601	Basic Life Support
B8602	Prevention and Treatment of Field-Related Injuries
B8603	Combat-Related Injuries
B8604	Casualty Evaluation and Evacuation

PHYSICAL TRAINING AND CONDITIONING. This subject is designed to provide the officer with an understanding of the nature and importance of physical fitness to include ways it can be developed and maintained. It is also designed to introduce the officer student to foot marches, unarmed combat and other physical training events routinely used to establish a unit physical fitness training program.

B8410.1	Physical Training and Conditioning
B8410.2	Nutrition, Weight Management, and Performance
B8410.3	Injury Prevention and Rehabilitation
B8410.4	Combat Physical Readiness Training

LEADERSHIP AND TRAINING. This instruction is designed to provide the officer with an understanding of the characteristics, principles, and techniques of leadership within the Marine Corps Leadership Program.

B0606	Philosophy of Leadership
B0607	Total Quality Leadership and Leadership Theory
B0612	Core Values: Professionalism and Ethics
B0619	USMC Counseling Program
B0621	Suicide Awareness, Substance Abuse & Homosexual Conduct Policy
B0623	Substance Abuse
B0624	The Role of the Marine Staff NCO
B0626	The Enlisted Marine
B0626.2	Developing Subordinate Leaders
B0628	Homosexual Conduct Policy
B0629	Equal Opportunity, Sexual Harassment & Fraternization
B0637	Training Management
B0637.1	Unit Training Management: Self-Paced Text Critique
B0639	Techniques of Military Instruction
B0660	Role of the Chaplain

PERSONNEL ADMINISTRATION. This subject is designed to provide the officer student with an understanding of the Marine Corps administration system, the fitness report system and naval correspondence.

B0141	Marine Corps Administration and Types of Naval Correspondence
B0142	The Marine Corps Directives System
B0143	Personnel Records
B0144	Enlisted Promotion Process
B0147	Types of Discharges
B0149	Security of Classified Material
B0150	Platoon Commander's Administration
B0151	Leadership Practical Exercise in Administration

MILITARY LAW. This subject is designed to provide the officer student with an understanding of military law with particular emphasis on those areas that are common to all company grade officers.

B4401	Introduction to Military Law
B4402	Investigations
B4403	Law of War
B4404	Criminal Law

AMPHIBIOUS OPERATIONS. This subject is designed to introduce the officer student to the fundamental principles of amphibious operations, to enable him to recognize naval amphibious ships, and to understand the Marine Corps role in amphibious operations.

B9900	Principles of Amphibious Operations
B9900.1	Amphibious Operations: Case Studies
B9901.1	Amphibious Ships, Landing Craft and Vehicles
B9909	Role of the Platoon Commander in Amphibious Operations
B9910	Ship-to-Shore Movement

NUCLEAR, BIOLOGICAL AND CHEMICAL WARFARE DEFENSE. This subject is designed to introduce the officer student to nuclear, biological, and chemical warfare defense. Particular emphasis is placed on those aspects of NBC defense that directly affect the company grade officer at the small unit level.

B5703	Field Protective Mask
B5705	NBC Protective Measures
B5705pt	Introduction to NBC Defense (Programmed Text)

TACTICS. This subject provides the officer with the basic knowledge necessary for a company grade officer to conduct small unit offensive and defensive operations. Included is instruction and application in the planning and conduct of combat patrols, helicopter borne operations, tank-infantry tactics, mechanized operations, military operations in urban terrain, and an introduction to rifle company operations.

B0301 & B0301A	Theory of War
B0303 & B0303A	Conduct of War
B0305	Operational Terms And Symbols
B0305.1	Operational Terms And Symbols: Programmed Text
B0305.2	Operational Terms And Symbols: Programmed Text
B0305.3	Operational Terms And Symbols: Programmed Text
B0305.4	Operational Terms And Symbols: Programmed Text
B0307	Marine Air-Ground Task Force (MAGTAF) Concepts
B0317.1	Initial Fireteam & Squad Tactics (Field Exercise)
B0319.2	Marine Battle Skills Training 3: Continuing Action (Field Exercise)
B0322	Development of Commander's Intent
B0324	Tactical Planning I
B0356	Tactical Planning II
B0326	Combat Orders I

B0328	Introduction to Patrolling
B0330	Conduct of the Patrol 1
B0332	Conduct of the Patrol 2
B0333	Conduct of the Patrol 3
B0334	Combat Orders II
B0337	Defensive Fundamentals I
B0339	Defensive Fundamentals II
B0339.8	Defensive Sandtable Exercise (STEX Packet)
B0349	Defensive Fundamentals III
B0350	Urban Patrolling I
B0351	Urban Patrolling II
B0354	Offensive Fundamentals I
B0355	Rear Area Security I
B0355.1	Rear Area Security II
B0355.2	Rear Area Security III
B0358	Combat Orders III
B0360	Night Attack
B0363	Introduction to Countermechanized Operations
B0363.8	Countermechanized Operations (STEX)
B0376	Movement to Contact
B0382	Mechanized Operations
B0386	Military Operations on Urban Terrain

SUPPORTING ARMS. This subject area is designed to provide the officer student with an understanding of the capabilities of supporting arms and the basic principles of fire support planning and coordination.

B0815	Introduction to Supporting Arms
B0829	Fire Support Coordination Measures
B0831	Fire Support Planning and Processing
B0833	Call for Fire

WEAPONS. This subject area is designed to provide the officer student with an understanding of the characteristics, capabilities, techniques of fire, employment, preventative maintenance procedures, and inspection techniques for weapons employed at the small unit level in all Fleet Marine Force organizations.

B2103	Service Pistol
B2105	Service Rifle
B2107	Introduction to Weapons Employment
B2109	M203 Grenade Launcher
B2111	M249 Squad Automatic Weapon (SAW)
B2113	Introduction to Antimechanized Weapons
B2117	Introduction to Mortars
B2121	Medium Machine Guns 1
B2127	Introduction to Machine Gun Employment
B2159	Heavy Machine Guns 1
B2161	Heavy Machine Guns 2

AVIATION. This subject is designed to provide the officer student with an understanding of the primary and collateral missions of Marine aviation; to understand the coordination required in an air/ground mission and to prepare as well as execute the same. Additionally, aircraft and weapons systems identification are stressed.

B7543	Introduction to Marine Aviation
B7545	Close Air Support (CAS) Procedures
B7551	Assault Support and Helicopterborne Operations
B7557	Helicopter Operations

FIELD ENGINEERING Instruction in this subject is designed to provide the officer student with an understanding of the principles of field engineering, to include military demolitions, emplacements/wire obstacles and mine/countermine operations that are common to all company grade officers.

B1315	Combat Engineering
B1316	Introduction to Mines
B1321.1	Engineering Skills (Field Exercise)
B1341	Engineers in the Defense

MILITARY OPERATIONS OTHER THAN WAR (MOOTW).

B0212	Introduction to Military Operations Other Than War (MOOTW)
B0213	Introduction to Terrorism
B0215	Counterinsurgency Principles
B0216	Combating Terrorism

PROFESSIONAL DEVELOPMENT. This instruction is designed to provide the officer student with instruction in subject areas that contribute to personal and professional development.

B6613	Uniforms and Accessories
B6622.1	Financial Planning
B6636.1	Augmentation and Promotion
B6670	Staff Organization and Function
B6680	Responsibilities of the Officer of the Day and Functions of the Interior Guard
B6690	Customs and Courtesies
B6690.2	Service Etiquette

7.2 Amphibious Warfare School

The Amphibious Warfare School is a 9-month course that provides career-level PME with emphasis on combined arms operations, warfighting skills, tactical decision-making and the Marine Air Ground Task Force (MAGTF) in amphibious and expeditionary operations. AWS prepares Marine captains to function as commanders and staff officers at appropriate levels within the Fleet Marine Force up to and including the Marine Expeditionary Brigade.

The course is divided into three phases. Phase I is dedicated to an examination of fundamental warfighting concepts, command and staff planning and MAGTF organization concepts. Phase II focuses in tactical applications in both the offense and defense. Each package in this phase culminates with a force-on-force Combined Arms Staff Training exercise and an Occupational Field Expansion Course (OFEC) where detailed MOS specific, tactics, techniques and procedures are taught. Phase III addresses the Marine Corps' role in Naval Expeditionary operations. This includes an introduction to expeditionary operations, MAGTFs in amphibious operations and Maritime Prepositioned Force (MPF) operations, and the MAGTF in Military Operations Other Than War.

The Amphibious Warfare School covers the following areas:

- **Leadership.** The Leadership package examines the nature of contemporary military leadership in terms of ethical and moral development. It is designed to enhance leadership skills through a combination of readings, lectures and symposia featuring modern day heroes and renowned academic scholars.
- **Professional Studies**. The Professional Studies package includes the Military History, Battle Studies, Effective Communications, and the Professional Reading Program.
- **Occupational Field Expansion Courses.** Instruction in this subject area offers students the opportunity to hone their individual Military Occupational Specialty (MOS) skills and to pursue interests in fields or endeavors related to the military profession in general.
- **Warfighting** This package establishes the philosophy of Warfighting as set forth in MCDP-1 as the foundation for all further instruction. The focus of instruction is on the doctrine of maneuver warfare, the nature of war and the theory and the role of the Marine Corps in national defense.
- **Command and Control** This package provides a basic understanding of the nature and application of the Command and Control process. Emphasizing the deliberate planning process, it provides a point of departure for further instruction in recognitional decision-making and rapid planning models.
- **MAGTF Offensive Tactics** The MAGTF Offensive Tactics package focuses on the development of sound military planning and execution and is designed to enable the student to apply an understanding of MAGTF organization and employment, integration of supporting arms and Combat Service Support operations in offensive operations.
- **MAGTF Defensive Tactics** This package complements the MAGTF Offensive Tactics package by emphasizing the planning and execution of MAGTF defensive tactics.
- **Expeditionary Operations** Instruction on MAGTF operations such as Maritime Prepositioned Force operations, MEU (SOC) operations, amphibious raids, rapid planning, Maritime Prepositioned Forces (MPF)

operations, Noncombatant Evacuation Operations (NEO) and Military Operations Other Than War (MOOTW) define the MAGTF role as part of the Naval Expeditionary Force.

- **Amphibious Operations** The Amphibious Operations portion of the Expeditionary Operations package offers an in-depth exposure to the planning requirements, command and control considerations, coordination complexities and planning documents required for the conduct of an amphibious landing.
- **MPF Operations** The MPF portion of the Expeditionary Operations package provides detailed tactics, techniques and procedures for the employment of MPF forces in various operations.
- **Military Operations Other Than War** The MOOTW program explores the Marine Corps' expanding involvement in this complex application of military force. Emphasis is placed on the role of the Marine Corps in a joint, combined, or coalition environment.

7.3 Command and Control Systems School

An alternative to the Amphibious Warfare School is the Command and Control Systems School[92] at Quantico, Virginia. This is a 10-month career-level PME course for captains (O3) in the application of the Marine Corps command and control philosophy in various warfighting areas. It also provides instruction in leadership, professional development, personal/family readiness, effective writing, battle studies and C2 applications. Like the Amphibious Warfare School, it prepares officers for command and staff billets at the O3 and O4 levels.

The Command and Control Systems School is comprised of five major courses.

Command and Control Philosophy. This course examines decision-making, command relationships, information prioritization, and technological impacts on military operations. This course emphasizes military commanders' needs for up-to-date situational awareness, operational demands for a common battlespace picture, and benefits of recognitional decision-making for high-tempo operations. This course provides the framework for remaining core curricula.

MAGTF Operations. This course examines operations/information interactions for each MAGTF element, and for an entire MEF. A two-day, scenario-based marked requirement tests students' ability to apply class material. Students make organizational, operational, and informational decisions, then define information flow paths to support this plan, and subsequently construct a technical architecture to support those information flow paths.

Naval Operations. This course introduces Navy warfighting philosophy and tactics, and shows how they contribute to the Navy/Marine team concept of expeditionary warfare. Students learn unique characteristics of naval forces, ship capabilities, and Naval command and control applications. Students apply the knowledge gained in another scenario-based requirement that emphasizes amphibious operations during operations other than war.

Joint Task Force Operations. This course introduces students to unique demands found with joint operations. In this course, students study joint task force command relationships, joint command and control systems, information flow paths, and intelligence information available for military operations.

C4I Planning and **Information Management**. This course introduces students to the technical application of information systems. Students become familiar with both *communication and data systems* resident in modern battlespaces, as well as *innovations looming on the technological horizon.* Additionally, students *design communication and data architectures* to support information flow throughout the battlespace.

7.4 Expeditionary Operations School.

In December of 2001, the Commandant of the Marine Corps directed that Amphibious Warfare School be merged with Command and Control Systems Course conducted by Command and Control Systems School. The merger of these two Captain level courses blended the best of both courses – the command and control emphasis of CCSC with the detailed instruction of Expeditionary Operations of AWS. The new school was designated the Expeditionary Operations School and its first class commences in August 2002.

7.5 Marine Corps Command and Staff College.

The Marine Corps Command and Staff College represents the Marine Corps intermediate PME course. The curriculum takes an integrated approach consisting of core courses, electives, and a final exercise. The first semester is entitled The Art and Science of War while the second semester is Warfighting ... from the Sea.[93] Throughout the year students also enroll in a core course entitled The Art of Command.

7.5.1 The Art and Science of War. This semester includes the Theory and Nature of War, Strategic Level of War, Art of Command, and Operational Level of War.

- The Theory and Nature of War. This course covers current aspects of military history, military theory, and military affairs.
- The Strategic Level of War. This courses examines the link between national military strategy and the broader aspects of national security policy.

- The Operational Level of War. This course covers operational warfare and campaign planning and directly applies concepts developed in the Theory and Nature of War and the Strategic Level of War.
- The Art of Command. This course deals with effective leadership techniques and the art of command.

7.5.2 Warfighting ... from the Sea. This semester includes Warfighting, Military Operations Other Than War, and the Final Exercise. The goal of these courses is to educate Marine students in the composition, functioning, and planning methodologies of the Marine Air-Ground Task Force (MAGTAF). Special emphasis is given to the Marine Corps Planning Process, offensive and defensive operations, joint amphibious and landing force doctrine, and the requirements of joint and multinational operations.

7.5.3 Electives Program. During the second semester, students take one elective course. Table 7.1 shows a representative sampling of elective courses.

Table 7.1. Marine Corps Command and Staff College Electives.

The American Indian Wars	Indochina to Vietnam
Critical Periods in American Military History: The American Civil War	The American Revolution
Joint Warfighting	**Weapons of Mass Destruction**
Airpower: Evolution of Theory and Practice	Churchill As War Leader: WWII
Causes of War and Peace	

7.6 Marine Corps War College.

The mission of the Marine Corps War College is to prepare graduates for responsibilities as a member of the Command and Staff College faculty, and for follow-on senior command and staff responsibilities.

The curriculum is divided into two semesters over a 10-month program. The core course during Term I is War, Policy, and Strategy; during Term II the core course is National Security and Joint Warfare. Regional Studies is a common core course that runs the extent of the Marine War College course covering the Middle East, Asian Pacific, Europe, and Latin American regions. General Studies is also a common core course that runs throughout the 10-month program and includes an Independent Research Project, Executive Writing and Speaking, and Leadership/Contemporary Challenge.

The student body generally consists of 7 Marine officers including an officer from the Marine Corps Reserve; 2 from the Navy, 2 from the Air Force, 2 from the Army; a Coast Guard officer; and a civilian representative from the Department of State, Department of Defense or other government agencies.

7.7 Professional Reading Program.

Marine Corps PME order, MCO P1553.4 prescribes the Marine Corps Professional Reading Program.[94] The Professional Reading Program provides lists of titles, sorted by rank, from which officers are required to read at least two selections each year. Additionally, a "Commandant's Choice" is published annually containing titles that every Marine is expected to read during the following year.

The Marine Corps Heritage.

1. *A Marine Named Mitch*, Paige
2. *U.S. Marines: 1775-1975*, Simmons
3. *Battle Cry*, Uris
4. *Fix Bayonets!*, Thomason
5. *Strong Men Armed*, Leckie
6. *The Right Kind of War*, McCormick
7. *The US Marine Corps Story*, Moskin
8. *Tarawa*, Sherrod
9. *Iwo Jima, Legacy of Valor*, Ross
10. *Flights of Passage*, Hynes
11. *Unaccustomed to Fear*, Willock
12. *Breakout*, Russ
13. *First to Fight*, Krulak
14. *Semper Fidelis*, Millett
15. *With the Old Breed*, Sledge
16. *Once a Legend*, Hoffman
17. *Fortunate Son*, Puller
18. *Reminiscences of a Marine*, LeJeune
19. *Chosin*, Hammel
20. *In Many a Strife*, Millett
21. *Once A Marine*, Vandegrift
22. *The Marine Corps' Search for a Mission: 1880-1898*
23. *LeJeune*, Bartlett
24. *Maverick Marine*, Schmidt
25. *No Bended Knee*, Twining

Leadership, Memoir, and Biography.

1 *A Message to Garcia*, Hubbard
2 *Fields of Fire*, Webb
3 *Battle Leadership*, Von Schell
4 *Rifleman Dodd*, Forester
5 *Marine*, Davis
6 *Uncommon Men: SgtsMaj of the Marine Corps*, Chapin
7 *Acts of War*, Holmes
8 *Challenge of Command*, Nye
9 *The Forgotten Soldier*, Sajer
10 *We Were Soldiers Once, And Young*, Moore and Galloway
11 *Three War Marine*, Parry
12 *Pegasus Bridge*, Ambrose
13 *Band of Brothers*, Ambrose
14 *Company Commander*, MacDonald
15 *Once an Eagle*, Myrer
16 *Profession of Arms*, Hackett
17 *Anatomy of Courage*, Moran
18 *Freeman on Leadership*, Smith
19 *Follow Me*, Newman
20 *Grant Takes Command*, Catton
21 *Morale: A Study of Men and Courage*, Baynes
22 *It Doesn't take a Hero*, Schwarzkopf
23 *Patton: A Genius for War*, D'Este
24 *Personal Memoirs of Ulysses S. Grant*, Long
25 *Years of MacArthur*, James
26 *The Quiet Warrior*, Buell
27 *100 Days: The Memoirs of the Falklands*, Woodward
28 *The General*, Forester

29 *Pershing*, Smythe

30 *Eisenhower's Lieutenants*, Weigley

31 *Nimitz*, Potter

32 *General of the Army: George C Marshall*, Cray

33 *Foundations of Moral Obligation*, Brennan

34 *Memoirs of General W.T. Sherman*, Royster

35 *Nightingale's Song*, Timberg

36 *My American Journey*, Powell

Theory, Nature, and History of War.

1. *Art of War*, Sun Tzu
2. *On Infantry*, English and Gudmundsson
3. *The Face of Battle*, Keegan
4. *Maneuver Warfare: An Anthology*, Hooker
5. *Gallipoli*, Moorehead
6. *For The Common Defense*, Millett & Maslowski
7. *On War*, Clausewitz
8. *Knight's Cross*, Fraser
9. *The Enlightened Soldier*, White
10. *Race to the Swift*, Simpkin
11. *Military Misfortunes*, Cohan
12. *Gates of Fire*, Pressfield
13. *What are Generals Made of*, Newman
14. *Generalship, It's Diseases and their Cures*, Fuller

Strategy, Policy, and Civil-Military Relations.

1. *U.S. Constitution*
2. *Declaration of Independence*, Jefferson
3. *Strategy*, Liddell Hart
4. *The Military*, Moskios
5. *Citizen Soldiers*, Ambrose
6. *Battle Cry of Freedom*, McPherson
7. *On Strategy*, Summers
8. *Makers of Modern Strategy*, Paret
9. *George Washington and the American Military Tradition*, Higginbotham
10. *The Making of Strategy*, Murray
11. *Eagle and Sword: Federalist and the Creation of the Military Establishment in America*, Kohn
12. *The Peloponnesian War*, Thucydides
13. *The 25 Year War*, Palmer
14. *A Democracy at War*, O'Neill
15. *Military Innovation in the Interwar Period*, Millett & Murray
16. *On the Origins of War and the Preservation of Peace*, Kagan
17. *Diplomacy*, Kissinger
18. *In Retrospect*, McNamara
19. *The Best and the Brightest*, Halberstram
20. *Dereliction of Duty*, McMaster

Operations, Campaigns, and Battles

1. *The Bridge at Dong-Ha*, Miller
2. *Fire in the Streets*, Hammel
3. *The Buffalo Soldiers*, Leckie
4. *Tip of The Spear*, Michaels
5. *Grant and Lee*, Fuller
6. *The Killer Angels*, Shaara
7. *Operation Buffalo*, Nolan
8. *BlackHawk Down*, Bowden
9. *The Middle Parts of Fortune*, Manning
10. *Devil Dogs*, Clark
11. *Landscape Turned Red*, Sears
12. *The Price of Glory*, Horne
13. *The Breaking Point*, Doughty
14. *Victory at High Tide*, Heini
15. *The Easter Offensive*, Turley
16. *No Victor, No Vanquished:Yom Kippur War*, O'Ballance
17. *Phase Line Green*, Warr
18. *The War of American Independence*, Higginbotham
19. *At Dawn We Slept*, Prange
20. *Guadalcanal, The Definitive Account*, Frank
21. *Defeat into Victory*, Slim
22. *Utmost Savagery*, Alexander
23. *Eagle Against the Sun*, Spector
24. *The General's War*, Gordon & Trainor
25. *Take That Hill! Royal Marines in the Falkland War*, Vaux
26. *The Campaigns of Napoleon*, Chandler
27. *To Lose a Battle*, Horne
28. *Korean War*, Ridgway
29. *A Bridge Too Far*, Ryan
30. *A Woman at War*, Moore

Chapter 8. Analysis of the Officer Professional Military Education System Through the Lens of Technical Competency.

The purpose for the extensive description of each of the Service PME systems in the preceding chapters is twofold. First, in order to assess the level of science and technology in the curriculum of each of the PME courses, establishing the current subject coverage in each was essential. Second, an understanding of the sequencing and attendance of officers at each Service school was important to any modification of the officer education system that would leverage the current PME schools as the framework for reform.

Given the focus within each of the armed services on the use of advanced technology weapons systems, one would expect to find a comparable focus within the officer PME system on education to instill a broad general understanding of the importance and application of science and technology to the art of war. A careful assessment of the curriculum of each of the armed services' PME systems shows this postulation is mistaken. With few exceptions, the officer PME system generally neglects the science and technology that enables advanced military systems. Recent changes within DoD have focused attention on improving technical awareness and demonstrate a commitment to reversing this trend. However, the level of detail remains insufficient to produce the technical competency necessary for officers to be effective at leading the U. S. Armed Forces in the 21st Century.

8.1 The Army PME System.

The current Army officer PME system is an extensive series of courses that enable officers to succeed in follow-on assignments. The courses are very focused on training with little inclusion of educational components until the officer attends the Army War College. Little science and technology education is found within the core programs of the Army PME courses. Because the Army culture values attendance at these schools, the PME courses provide a valid framework for future reform that would include educational short-courses focused on increasing officer technical competency.

Recently, as part of the Army's move toward providing a universal CGSOC education to all field grade officers, an independent contractor conducted a review of the current CGSOC curriculum. From an educational perspective, the results of this analysis were quite pejorative. The current CGSOC curriculum was described as providing neither a graduate-level experience nor the necessary intellectual rigor or practical mastery required for officers to deal with operations in the present environment.[95] Regrettably, the present characterization of the CGSOC curriculum echoes a similar study from nearly 45 year ago, which stated that CGSC "still exhibits many of the characteristics of lower schools that are devoted almost exclusively to military training."[96] An analysis of the curriculum against the six levels of Bloom's Taxonomy was conducted. Of the 552 hours in the Term I core curriculum, nearly 248 classroom hours were categorized as fact-based versus conceptual problem solving and at the lowest-level of the taxonomy – knowledge and comprehension.[97] The Advanced Application Program electives, which comprise Terms II and III, consist of 1,995 hours of which 1,057 involved learning again at the knowledge and comprehension

levels of the taxonomy. An additional 110 hours of fact-based classroom instruction involved teaching TRADOC mandatory subjects.

The Army War College core curriculum provides limited coverage of science and technology subjects. Lessons on *Science, Technology, and Transformation*, *Information Operations*, *Future War*, and *Transformation* provide an important introduction to some of the issues related to technology in current and future warfare. When compared to the objectives in Bloom's Taxonomy the percentage of the core curriculum achieving each of the levels of the taxonomy were determined as: 3% knowledge, 21% comprehension, 21% application, 27% analysis, 7% synthesis, and 21% evaluation.[98] Additionally, an external assessment of the Army War College curriculum found that "critical thinking needs to be stressed throughout the course."[99]

In response to numerous interviews with former students, faculty, and external evaluators, some additional comments about the Army War College are warranted. The Army War College curriculum is the most individualized of the Senior Service Colleges surveyed for this report. Only the first semester contains a core course curriculum with the remaining semesters being tailored to each officer's interests through an extensive series of elective courses. This approach encourages individualized education at the expense of a shared educational experience focused on common themes relevant to the art of war. Some would also argue that the veiled purpose of the Army War College is to provide highly competitive officers with a much-needed respite from a fast-paced, high-pressure career and a social environment in which prospective senior leaders establish important interpersonal relations that will serve them and the Army later in their career. In this case, the Army has

lost an important educational opportunity and resigned itself to providing merely a mediocre senior-level PME education.

While there are courses within the Army PME system that cover technical subjects pertinent to the science and technology of the modern battlefield, these courses were predominately either specialty training or elective courses that impact only a small percentage of the officer population.

The CSA Professional Reading Program does not encourage books on science and technology innovation. Of those listed in the current program, *Military Innovation in the Interwar Period* by Williamson Murray and Alan Millett is the only one that addresses subjects related to technological innovation, understanding RMAs, or leading change in complex organizations.

8.2 The Navy PME System.

Of all the armed services, the Navy appears to place the least emphasis on the importance of PME. Interviews with Naval officers and the findings of the Navy Graduate Education and Training Working Group confirm this institutional bias. The Navy culture has been and continues to be focused on the handling of ships. Whether at war or in peace, the Navy has to operate its vessels and has always insisted that the best teacher was experience.[100] This culture persists today with increased emphasis within the institution, whether implicit or explicit, on operational experience rather than education. Beyond the cultural resistance to recurring education, one of the unique challenges within the Navy is that officer PME is specialized within each of the specific warfare communities. Although the recent integration

of the 2-week Leadership Continuum courses provides a common PME course framework, it is doubtful that the short-duration will support additional science and technology subjects. The next opportunity for all Navy officers to attend a common PME course is the College of Naval Command and Staff. However, only a small percentage of officers attend or complete this PME course. Within the individual warfare communities, aviators receive the least periodic PME. With the exception of Replacement Aircraft Group (RAG) refresher flight training following shore duty, the College of Naval Command and Staff is the first formal PME school following completion of flight training.

As of September 2001, the Navy officer corps numbered 58,908 total officers.[101] Of this total, 48% or 26,037 were Unrestricted Line (URL), 41% or 22,123 were Restricted Line (RL) and Staff and the remaining 11% or 5,748 were Limited Duty Officers (LDO) and Chief Warrant Officers (CWO). Within the URL, 50% or 12,977 were Aviation, 32% or 8,227 were Surface Warfare, and 14% or 3,572 were Submarine Warfare.

The Division Head and Department Head courses taught to Surface Warfare Officers and the Nuclear Power Course taught to Submarine Officers provide some of the most comprehensive science and engineering education found in any of the Service officer PME courses. Coverage of fundamental physics, thermodynamics, electromagnetism, capacitance and inductance, and power generation provides these officers with a solid foundation in these applied physical sciences. Missing from these curricula, however, is coverage of information technology and communication networks, sensor science, elements of chemistry and biotechnology, and quantitative and analytic skill categories. However, given the physics and engineering background developed in these courses, this population of officers should easily and quickly master these additional technical subjects. The Surface Warfare and

Submarine Warfare officers that take these PME courses represent roughly 20% of the total Navy officer corps and 45% of the URL officers in the Navy.

One distinction within the current Navy PME system is that operational warfighting receives only limited coverage – 12 weeks – in both the College of Naval Command and Staff and the Naval War College. The other Services dedicate their entire Command and Staff Colleges to this important operational focus. The distinction between the College of Naval Command and Staff and the College of Naval Warfare is not in the subject coverage but instead in the experience and application of the student population. The impact of this on any future educational reform that would teach short-courses on science and technology is that these officers would miss the integration of science and technology with an operational-level focus on doctrine and applications.

While the curriculum in the Naval Command and Staff College and the College of Naval Warfare does not include specific coverage of science and technology fundamentals, it does provide important coverage of issues related to technological innovation, leading technological change in complex organizations, and understanding RMAs. These subjects are included in both the core curriculum and elective programs. At the senior-level of PME, these subjects are an important part of science and technology education. Analysis of the core courses of these two PME colleges shows that learning achievement within Bloom's Taxonomy is equally divided into application, analysis, synthesis, and evaluation.[102]

While the Navy officer PME system provides a substantial focus on technical subjects within each warfare community, it currently lacks the cross-cutting science and technology issues affecting the Navy as an institution. Instead, the Navy is extremely compartmentalized within the 3 warfare specialties: surface, submarine, and aviation.

Furthermore, beyond the PME received at the O-1 and O-3 levels, all Naval officers do not routinely return to common PME courses later in their career. This would make it difficult to develop and progressive education for all Naval officers in science and technology beyond mid-career without resorting to correspondence or distance learning methodologies.

The CNO Professional Reading Program contained some diversity from the other Service reading lists. It included the single most technical book in all of the reading lists: *A Brief History of Time: From the Big Bang to Black Holes* by Stephen Hawking. This book discusses important contemporary scientific theories dealing with the origins of the universe, black holes, wormholes, quarks, and time travel. With this exception, the remainder of the reading list, like the other professional reading lists, contained no books covering relevant science and technology, military innovation, or leading change in a complex organization.

8.3 The Air Force PME System

The Air Force PME system is the closest to an *educational* system of all of the Services. The Air Force specifically separates training courses from the education courses within the officer PME system. The Air Force brings all of its officers to common PME schools from the beginning of their career. Some would argue that this is part of an elaborate plan intended to continuously indoctrinate all Air Force officers in the benefits of air power. Regardless, this system provides a comprehensive PME framework that can be leveraged in any future education reform that would include coverage of science and technology within the existing PME system.

Within the Air Force PME system, only limited coverage of science and technology is included. The Air and Space Course and Squadron Officer School are both short duration courses focused on the Air Force culture and leadership. The Air Command and Staff Course includes only minimal coverage of science and technology issues. When compared to objectives in Bloom's Taxonomy, the core course achieves approximately ¾ comprehension, application, and analysis with the remaining ¼ of the curriculum divided into synthesis and evaluation.[103] The Air War College includes coverage of the Air Force research and development process during the core curriculum and provides more electives on science and technology than any of the other PME systems including such titles as *Technology and World War I*, *Strategy and Technology I and II*, and *Chemical and Biological Warfare Issues for the USAF*.

The CSAF Professional Reading Program appeared to be an extension of the Air Force indoctrination on air power. Nearly every book on the reading list focuses exclusively on the history of the Air Force and a historical analysis of air power in various campaigns. Virtually no books on science and technology, military innovation, or leading change in a complex organization are included.

8.4 The Marine Corps PME System.

The Marine Corps PME system lacks any serious coverage of science and technology issues. Narrow exposure to communications and communication security, and electronic warfare are provided in the Basic School. The Amphibious Warfare School is exclusively dedicated to combined arms operations, warfighting skills, tactical decision-making, and MAGTAFs in

amphibious and expeditionary operations. The Command and Control Systems School provides the most emphasis on technology in any of the Marine Corps PME schools but is generally attended predominately by specialists. While exclusively focused on information technology and communications networks, this school provides the officer with an exceptional understanding of these subjects. Coverage includes information prioritization, technological impacts on military operations, joint command and control systems, information flow paths, communication and data systems resident in modern battlespaces, as well as innovations looming on the technological horizon. The new Expeditionary Operations School represents an important change in Marine Corps officer education that marks inclusion of technology subjects in a mainstream Marine Corps PME school. The Marine Corps Command and Staff College again focuses on combined arms operations, warfighting skills, decision-making, and amphibious and expeditionary operations. When compared to the objectives in Bloom's Taxonomy, the first semester achieves application and analysis, the second semester is primarily knowledge and comprehension, and the final exercise focuses on synthesis and evaluation.[104] The Marine Corps War College is an exclusive school enrolling only 15 students each year, most destined to faculty positions in the Marine Corps Command and Staff College.

The Marine Corps Professional Reading Program closely parallels most of the Marine Corps PME system including no books related to science and technology, military innovation, or leading change in a complex organization.

8.5 Officer Attendance at PME Courses.

If a change in officer education is to leverage the current officer PME systems, it is important to understand the population of officers from each Service that complete the PME courses. Figure 8.1 shows the percentage of officers from each Service that complete intermediate- and senior-level PME as well as those that complete both[105].

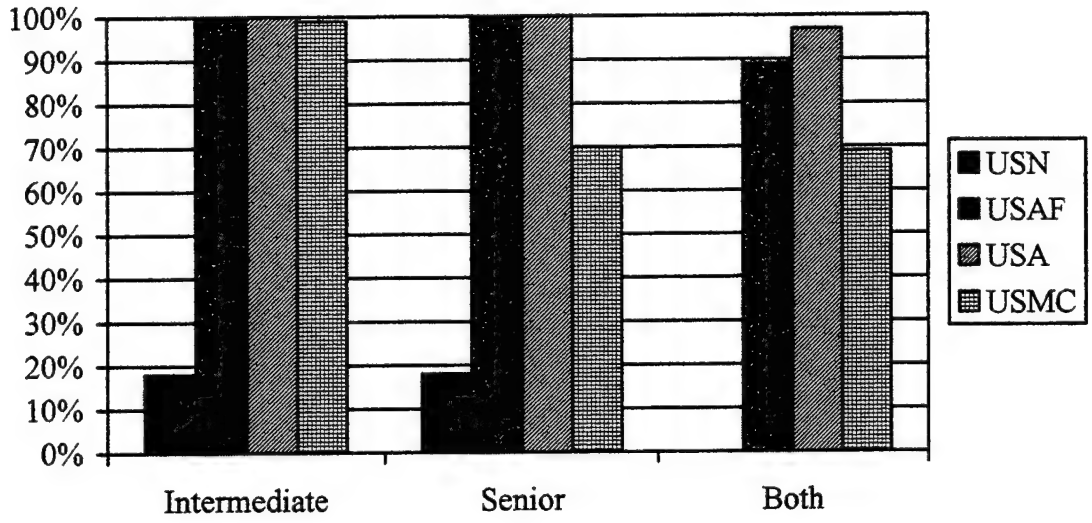

Figure 8.1. Service Completion of Intermediate- and Senior-Level PME Institutions*.

* The Navy does not maintain records that differentiate between senior officer attendance at intermediate- and senior-level PME schools. According to 2001 data, 36% of O-6s had attended one or the other.

An important distinction between Navy officers and their counterparts in the Army, Air Force and Marine Corps is that by the time officers reach the grade of O-6, 100% of Army and Air Force officers complete the intermediate- and senior-level PME courses while this percentage is much lower for Naval officers, being only 36% that attend *either* the intermediate- or senior-level PME courses. This, in part, is due to the commonality of these

two curricula but also reinforces the Navy culture that places more emphasis on operational experience than repeated educational experiences.

This analysis identifies an obstacle to improving officer technical competency by integrating short-course-style educational modules into the existing Navy PME framework. As a result, an alternative delivery mechanism must be investigated for the Navy to provide science and technology education. The logical alternatives are distance learning and correspondence course formats.

8.6 Joint PME Requirements.

The single overarching authority for officer PME within each of the Services is the guidance provided by the Chairman of the Joint Chiefs of Staff (CJCS). CJCS Instruction 1800.01A, *Officer Professional Military Education Policy*,[106] provides guidance for all Service PME institutions regarding policies, procedures, objectives, and responsibilities for officer PME. It is interesting to note that CJCSI 1800.01A specifies Levels of Learning Achievement[107] according to *Know*, *Comprehend*, *Value*, *Apply*, *Analyze*, *Synthesize*, and *Evaluate*, which combines elements of Bloom's Taxonomy of Cognitive Learning with elements of Krathwohl's Affective Taxonomy[108].

At the Primary Level of JPME, which encompasses branch, warfare, and specialty schools, *no* specified learning areas are dedicated to understanding science or technology or its role within the armed services. At the intermediate-level of JPME, 1 of the 5 specified learning areas is dedicated to understanding technology and its role in the Armed Forces.

Learning Area 5 – Information Operations (IO) and Command, Control, Communications, and Computers (C4) specifies the following educational objectives:[109]

a. Understand how command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR) systems apply at the tactical and operational levels of war and how they support a joint information operations (IO) strategy.
b. Comprehend how IO must be integrated to support national and military strategies.
c. Comprehend how IO is incorporated into both the deliberate and crisis action planning processes at the operational and JTF levels.
d. Comprehend how opportunities and vulnerabilities are created by increased reliance on information technology throughout the range of military operations.

At the senior-level of JPME, the learning areas focused on science and technology are expanded to encompass 2 of the 5 Learning Areas. Learning Area 5 – IO and Command, Control, Communications, and Computers (C4) specifies the following educational objectives:[110]

a. Understand IO and C4 concepts and how they relate.
b. Demonstrate a thorough understanding of how IO and C4 are integrated to support the National Military and National Security Strategies and interagency process.
c. Demonstrate how IO and C4 are integrated into the theater and strategic campaign development process.
d. Understand how the joint operational planning and execution system is integrated in theater and operational IO campaign planning and execution to support theater and national strategic sustainment and warfighting efforts.

Learning Area 6 – The Role of Technology in 21st Century Warfare specifies:[111]

a. Comprehend how technological change affects the art and science of war and evaluate key ongoing and anticipated technological developments pertinent to the military instrument.
b. Analyze JV 2020 and the nature of warfare in the information age, to include examining key current developments.

While CJCSI 1800.01A specifies these learning areas, each Service is responsible for implementation of this guidance. CJCSI 1800.01A provides that "Each college will fulfill the appropriate joint learning objectives and generally have a curriculum that includes" these learning areas.[112] It is not clear at this time that these specific changes in CJCS JPME learning areas have been fully implemented within each PME institution or whether the institutions have interpreted inclusion of these subjects within elective courses as constituting adherence to the policy. Based on the analysis of each of the current Service PME curricula, at present these new learning areas are not fully implemented within the core courses of all intermediate- and senior-level PME institutions. It is expected, however, that given this recent update to CJCS guidance on JPME coverage that in the future, increased emphasis on at least IO, C4IRS, and the role of technology in modern warfare will increase at all intermediate- and senior-level Service PME institutions.

8.7 The National Defense University.

There exist several other PME institutions in addition to those administered by the individual Services. These are considered JPME institutions and are administered by the National Defense University[113]. Colleges within the National Defense University system include the Joint Forces Staff College, the National War College, and the Industrial College of the

Armed Forces. For completeness, the curricula of these JPME institutions are reviewed here for science and technology coverage.

8.7.1 Joint Forces Staff College.

The Joint Forces Staff College (JFSC) is a JPME institution composed of three unique schools and an overview course: the Joint and Combined Staff Officer School (JCSOS); the Joint and Combined Warfighting School (JCWS); the Joint Command, Control, and Information Warfare School (JCIWS); and the Joint Transition Course.[114]

8.7.1.1 Joint and Combined Staff Officer School. This school consists of a 330-hour resident program covering fifteen academic objectives that define the JPME Phase II. Subjects covered include Strategy, Campaigning, Deliberate Planning, and Crisis Action Planning.

8.7.1.2 Joint and Combined Warfighting School. This 12-week senior-level program is, relatively speaking, a narrowly defined curriculum emphasizing the application of joint planning, doctrine, procedures, and perspectives. It is designed to be taught within the broader context of national security now found in the core curriculum of Service war colleges. The primary focus of the program is on joint warfighting and planning considerations at the combatant command level.

8.7.1.3 Joint Command, Control, and Information Warfare School. This school is comprised of 3 separate courses. The Joint Command, Control, Communications, Computers, and Intelligence Staff and Operations Course (JC4ISOC) is a 4-week course that acquaints non-technically oriented students with the wide range of C4I operations that extend through the national, theater, and tactical levels of command. The Joint Information Warfare Staff and Operations Course (JIWSOC) is a 2-week course that prepares students for duty as joint or multinational information warfare (IW) staff

officers or Service IW officers operating in a joint environment. The Joint Information Operations Planning Course (JIOPC) is a 1-week course offering students advanced information and techniques to conduct IO deliberate planning.

8.7.2 National War College.

The National War College (NWC) is a senior-level JPME institution with a curriculum focused on national security strategy. It provides graduate education with an emphasis on both the joint military and interagency dimensions of national security strategy.

The core curriculum consists of the following courses[115]:

5601: Fundamentals of Strategic Logic
5602: Nature of War
5612: Joint Force Capabilities
5603: The Inter-Agency Process
5604: Doing National Military Strategy
5605: The Global Security Arena
Crisis Decision Exercise

In addition to the core curriculum, 4 elective courses are required during the 10-month course, 2 taken each semester. One of those courses must be an elective related to the overseas regional study seminar.

NWC students have the option to enroll in the Information Strategies Concentration Program (ISCP) specialized curriculum in lieu of other elective courses. The ISCP focuses on the information component of national power in the planning and execution of national strategy, military strategy, and joint operations.

8.7.3 Industrial College of the Armed Forces.

The Industrial College of the Armed Forces (ICAF) is the only JPME institution that emphasizes the management of national resources to support national security strategy. The ICAF curriculum provides a broad education in national security strategy and national military strategy with special emphasis on resources management. The Fall Semester core curriculum is National Security Strategy while the Spring Semester is Resources Management.

National Security Strategy objectives are achieved through the academic disciplines of Political Science, Economics, Strategic Leadership, Grand Strategy, and Military Strategy and Warfare. Resources Management objectives are achieved through the academic disciplines of Elements of National Power, Strategic Logistics and Mobilization, Acquisition, Economics, Information Systems for Strategic Leaders, and Industry Studies.

Representative electives offered at ICAF at listed in Table 8.1.[116]

Table 8.1. Industrial College of the Armed Forces Elective Courses.

Professional	Regional Security Studies
150 Executive Writing	5190-01 Russia/CIS
160 The Career Architect: Individual Assessment and Development Planning	5190-02 China
Grand Strategy	5190-03 NATO Europe
5001 Blacks in American Military History	5190-04 European Union
5010 America in Vietnam	5190-05 Mediterranean Littoral
5015 Business and the American Way of War	5190-06 Eastern Europe
5022 Congress and National Security Policy	5190-07 Middle East
5025 Latin American Military Operations	5190-08 Northeast Asia
5030 France: In Search of a Grand Strategy	5190-09 Southeast Asia
5031 The Peace that Failed: 1918-1941	5190-10 South Asia
5035 Law for the Defense Manager	5190-11 Central America
5175 Public Policy Formulation: "Think Tanks"	5190-12 South America
Strategic Decision Making	5190-13 Canada
5053 Strategic Negotiations	5190-14 Sub-Saharan Africa
5055 Strategic Reconciliation	5190-15 Oceans
5060 American Generalship: Character is Everything	5190-16 Mexico

5061 The Strategic Executive	5190-17 Japan
5066 Handling Complex National Security Events	5190-18 South Pacific
5068 Ethics: Meeting the Challenges of Strategic Leadership	Economics
5072 Lessons in Leadership	**5203 Economics and Information Technology**
5074 Congress	5204 International Economics
5077 Creative and Critical Thinking	5205 Modern War as an Economic Struggle
5078 Shaping Effective Organizations	5206 Economics and National Security
Political Science	5208 Macroeconomics for National Security Strategy
5151 Latin America and The United States	5209 Corporate Finance
5152 Comparative Intelligence Systems	5211 Government Finance
5153 Intelligence and National Policy	5212 Economic Diplomacy and Economic Warfare
5154 The News Media	Elements of National Power
5157 The History of Russia in World Affairs	5251 The World of Education
5159 Classical Readings in Political Thought	5257 Insider's View of American Industry
5161 Assessing and Managing Ethno-Political Conflict	Mobilization
5169 Terrorism: Threat and Response	5352 Resourcing The American Civil War
5170 Critical Social Issues and National Security	5361 Domestic Emergency Response Operations
5172 Political Psychology for National Security Decision Makers	Acquisition
5176 The Western Hemisphere - Global Issues	5305 Global Strategic Management
Joint Military Logistics	**5306 Non-Lethal Weapons**
5267 Logisticians and Warfighters (JLASS) I	5307 Acquisition Case Studies
5267 Logisticians and Warfighters (JLASS) II	5308 A Manager's Guide to COTS-Based Systems
5270 Business Logistics Management	5313 Acquisition Policy I
5271 Advanced Business Logistics Management	5314 Acquisition Policy II
5272 Historical Readings in Logistics	
5273 Mobilization, Past, Present and Future	
5274 Revolution In Joint Military Logistics	
5275 Logistics: The Interagency Dimension	

8.7.4 CJCSI 1800.01A and the National Defense University System.

It is particularly interesting that **none** of the learning areas specified in CJCSI 1800.01A for JFSC, NWC, or ICAF contain **any** reference to science and technology. The learning areas dealing with IO, C4ISR and the role of technology specified for Service PME institutions in CJCSI 1800.01A are not included in the requirements of the National Defense University system. As a result, these PME institutions provide even less coverage of science and

technology than do their Service counterparts. The single encouraging development within the NDU system in relation to science and technology is the establishment of the Center for Technology and National Security Policy[117] in 2001. While still in its infancy, this center holds the potential to influence future curricula within the NDU system and possibly lead change within DoD.

The trend away from science and technology competency in these institutions is in stark contrast to their beginnings. Initial plans for the National War College were based on the "conviction that senior planners should be prepared to deal with problems of a scientific nature, such as the impact of new weapons."[118] The first Commandant of the National War College, Admiral Hill in testimony before a House committee several months before the opening of the institution said the program would commence with lectures by scientists regarding the meaning of the new scientific age.[119] He explained that the college would not try to make mathematicians or scientists out of the students, "but we want to inform them in the development of scientific progress and inform them of what may be expected in the next four or five years."[120] Subsequently, the scope of the National War College as approved by the Joint Chiefs of Staff includes study of the impact of science and technology upon the armed forces.[121] In 1945, Vannevar Bush advocated "an advanced military college devoted to the evolution of weapons and its relation to strategy."[122] Masland and Radway disagreed with the need for a separate school, however, they did recognize the need for military officers to have more knowledge of scientific principles and developments.[123] A similar conclusion was drawn by a special board established by the Joint Chiefs in 1954 to survey the National War College and the Industrial College of the Armed Forces. This board concluded that more emphasis at these schools should be placed upon scientific and technical factors.[124] It is

incomprehensible to believe that 56 years after the establishment of the National War College, technical competency of the officer corps is less important to the Armed Forces.

8.8 Implications for Educational Reform.

The analysis presented in this chapter demonstrates that the current officer PME curricula within each of the Services provide inadequate coverage of the underlying science and technology given the importance of technology to each of the Services. While the recent update to CJCS guidance on JPME specifies increased coverage of IO, C4ISR, and the role of technology in the 21st Century, it nonetheless falls short of the coverage necessary given the importance of advanced technology to modern weapon systems. Also, the educational objectives specified for these new technical learning areas are at the equivalent understanding and comprehension levels of Bloom's Taxonomy and are effectively survey in nature. Particularly troubling is the clear distinction in science and technology coverage between Service PME institutions and the NDU JPME institutions. Finally, officer educational demographics establish that Navy officer attendance at periodic and progressive PME schools is divergent with the other Services.

The current officer PME system is a product of Cold War specialization and does not provide the necessary cross-cutting technical competency required of officers in the 21st Century. The officer PME system has become decoupled from the technologically advanced weapons systems that have become synonymous with the U.S. Armed Forces. Consequently, it lacks any serious focus on science and technology education and therefore does not

adequately prepare officers for their role as leaders who must lead soldiers, sailors, airmen, and marines employing these advanced weapon systems.

Any educational reform in the officer PME system must necessarily be tailored within each individual Service. Within the Army, Air Force, and Marine Corps, this transformation can be accomplished by integrating individual science and technology short-course-style modules into the existing officer PME courses. Within the Navy, this approach will achieve only limited success because of the diverse PME progression within each of the warfare communities and the aperiodic nature of officer attendance at PME schools. Consequently, an alternate approach to technical education must be developed for the Navy with the most promising candidates being distance learning and correspondence course programs.

Chapter 9. Toward a Prototype Educational Framework.

> I know of no safe depository of the ultimate powers of the society but the people themselves; and if we think them not enlightened enough to exercise their control with a wholesome discretion, the remedy is not to take it from them, but to inform their discretion by education. This is the true corrective of abuses by constitutional power.
>
> — Thomas Jefferson
> Letter to William C. Jarvis, September 28, 1820

Officers in the U.S. Armed Forces are adults who possess varying degrees of experience. As an officer progresses in rank throughout a military career, the breadth and depth of knowledge and understanding required in a specific subject necessarily changes. The breadth and depth of science and technology education within the officer corps must therefore be tailored to the grade and experience of the officer. Consequently, officer grade and experience provides a natural framework in which to develop educational modules with the appropriate breadth and depth of scientific content. This career progression also provides a natural framework in which to transition from pedagogical learning to andragogical learning. Although all officers are adults, junior officers lack sufficient military experience to provide educational motivation and focus. It is therefore logical that education at the junior officer level focus more on pedagogical theory in which the teacher articulates why it is important to understand specific concepts within the context of modern warfare. By mid-career, a more andragological learning style is appropriate.

In developing any educational curriculum it is equally important to consider Bloom's Taxonomy of Cognitive Learning. While the courses envisioned for this education reform are short in duration, this does not preclude course curricula that achieve higher-levels of

learning in Bloom's Taxonomy. In the development phase, the duration of the course and the course content must be balanced to ensure sufficient coverage of fundamental concepts is achieved and appropriate examples and exercises are developed to achieve the desired higher level cognitive learning. It is therefore important to include problems and questions that force the students to higher levels in the taxonomy. Integrating a technical component into the existing officer PME systems and making that component periodic and progressive like the existing programs provides several advantages. First, it ensures that cross-cutting technical competencies are reinforced throughout an officer's career, progressively building on previous educational experience. These periodic courses develop officers with technical competency appropriate to the grade, branch, and warfare specialty. Additionally, using this progressive approach, not only can individual courses be designed to achieve higher-levels of cognitive learning but the cumulative educational program will achieve and reinforce learning at the higher levels of the taxonomy.

Specifically, it is desirable for officers to reach at least the analysis-level within the taxonomy in an individual course. An example from a tactical Army sensor science application demonstrates this hypothesis. Night vision devices can be grouped into two very broad categories: forward looking infrared (FLIR) imaging systems and image intensifiers. FLIR imaging systems, sometimes referred to as thermal imaging systems, are passive devices that respond to radiation *emitted* from a target in the infrared (IR) portion of the electromagnetic spectrum. Current FLIR sensors operate across several different regions of the electromagnetic spectrum, the most common being 3 – 5 micrometers (μm) and 8 –12 μm, described as mid-wavelength infrared (MWIR) and long-wavelength infrared (LWIR), respectively. There are many different natural and manmade obscurants that can affect both

FLIR and image intensifier systems depending on the relationship between the obscurant particle size and the wavelength of the electromagnetic radiation. Indirect artillery and mortar fire can deliver white phosphorous (WP) smoke which contains particles with a diameter in the range of 0.1 – 1.2 μm. These particles cause scattering and absorption of the electromagnetic radiation in the visible and SWIR portion of the electromagnetic spectrum making this obscurant effective against image intensifiers operating in these spectral bands. Smoke generators like the M56 Coyote and M58 Wolf can suspend graphite particles that are in the range of 3.5 – 7.0 μm in diameter in smoke that extends the range of effectiveness of this obscurant into the MWIR spectral band making this obscurant effective against MWIR FLIR systems. An officer that has learned the subject of sensor science at the analysis level of the taxonomy should understand the relationship between obscurant particle size and sensor wavelength and be able to determine the obscurant type from an intelligence estimate, describe the approximate particle size of the obscurant, and select the appropriate sensor that maximizes the sensing range. The skills demonstrated by an officer that achieves the analysis-level of learning in this example include *recognizing* the relationship between wavelength and obscurant particle size, and *selection* of the appropriate sensor wavelength to maximize sensing range. Reaching the analysis level of the taxonomy provides officers with sufficient technical competency to make these types of educated tactical decisions. The periodic and progressive nature of the PME courses review and reinforce previous material and incorporate it into newer, expanded material and applications. By proper design, it should be possible to leverage the officer's military experience and the progressive PME education to achieve the synthesis and evaluation levels of the taxonomy by the time the officer attends the senior-level PME course.

This periodic and progressive approach to education has been used successfully elsewhere. In the civilian university environment, this is accomplished within a specialized framework by progression from lower-division to upper-division courses. Periodic and progressive also describes the current Army approach to PME. Applying this template to science and technology education within the officer PME system to achieve higher-levels of cognitive learning reflects the changed relationship between officers and technology.

Since technical competency in the officer corps is focused on the application to the art of war, the teaching methodologies discussed earlier provide an effective framework for short-course development. The Socratic method can be effectively integrated into questions posed to students. The Thematic method can be used to develop a context for the understanding of a specific science and technology within an application area. *Visualizing a Digitized Battlefield* [125] was based on a thematic methodology in which sensor science, digitization, communications networks, and display technology were integrated within the context of battlefield visualization and a common operating picture. Experiential learning can also be included through the use of practical exercises.

9.1 Officer Education Reform

The educational needs of the officer corps vary according to the grade, responsibility, and experience of the officer. Junior officers who are closely associated with specific military systems require an in-depth understanding of both the science and systems they are employing. At the lowest tactical levels, this education can be focused on a limited number of military systems. As officers progress in rank and responsibility, the breadth of coverage

must expand to cover a larger set of systems. Senior officers who are developing doctrine and are involved in force planning require a different level of understanding and breadth of coverage of the science and technology of many different systems. A logical association between the officer's grade and educational experience can be made to the three levels of warfare – tactical, operational, and strategic. The existing PME system within each Service parallels these levels of war by providing schooling at various times throughout an officer's career that correspond directly with these different levels of war.

One approach to reforming the current officer educational system includes adding coverage of the science and technology of modern military systems at each school within the PME system. In this way, the coverage can be focused to insure the officers are receiving appropriate topics and system coverage. While some of the detailed system-level training is already being done at the branch, warfare, and specialty schools, more of the underlying science education needs to be included. The approach advocated here was applied to a 2-day short course developed and taught by military faculty from the United States Military Academy at West Point, New York to officers enrolled in the Advanced Warfighting course at the U.S. Army Command and General Staff College, Fort Leavenworth, Kansas.[126] This short-course was developed specifically for mid-career officers who would be in battalion and brigade leadership positions during the fielding of the Army's digitized units and covered such topics as electromagnetic radiation and sensors, acoustic sensors, the basics of lasers, digitization fundamentals, network protocols and architectures, and power sources. This course was designed using a thematic learning methodology that demonstrated the relevancy of the material to the officers and reinforced the course content using scenario-based practical examples and peer instruction[127] techniques. Other similar short courses with

varying course content and focus could be similarly included in other course curricula within the existing officer PME system to accomplish this educational transformation. These short-courses can also be delivered within the Navy using distance-learning mechanisms.

Another potential venue to improve officer technical competency is each Service's Professional Reading Program. Inclusion of a text such as *The Discoverers* [128] by Daniel J. Boorstin that provides an overview of the historical development of technological innovation and its subsequent acceptance by and impact on society would help officers better understand and lead technological change. Finally, with the increased focus on web-access and the Services' commitment to distance learning, the PME system can also integrate on-line professional development courses to enhance and reinforce officer understanding of some of the fundamental science and technology topics discussed here.

The following represents a suggested outline for a revised officer educational program that can accomplish the necessary education reform. This educational transformation retains the current focus on the tactical, operational, and strategic levels of war tactics, doctrine, strategy, and history; and also includes appropriate breadth and depth of science and technology education at each level within the PME system for each specific audience.

Pre-Commissioning.

- Require core courses in mathematics and the applied physical sciences including physics and chemistry. Require electives in the area of information technology and freshman engineering.

Basic Branch, Warfare, and Specialty Courses.

- System coverage should be limited to branch, warfare, and specialty specific and cross-cutting systems found at the platoon, company, division, and squadron levels.
- Focus on the science and technology of application-specific systems and cross-cutting systems including information technology and communications networks, sensor science, chemistry, biotechnology and nuclear energy and radiation, and military physics and engineering employed at the tactical level of war.

Advanced Branch, Warfare, and Specialty Courses.

- System coverage should remain focused on systems found at the company, battalion, ship, squadron, and wing level and should begin to include closely associated supporting systems.
- Expanded science and technology should reinforce cross-cutting fundamentals associated with the tactical environment and should begin transition to the operational level of war.

Command and Staff College.

- System coverage should expand to the battalion, brigade, division, group, and task force level and include combined arms and joint systems.
- Science and technology should reinforce crosscutting basics and focus on the operational level of war.

Pre-Command Courses.

- System coverage and science and technology should be focused and command specific. Provide a targeted primer in the form of a "smart book" that provides insights on the specific military systems associated with the unit.

Professional Development Courses.

- Individual reading, correspondence, and continuing education courses covering the science and technology of various systems from the tactical to strategic level.

Senior Service Colleges.

- System coverage should include major military systems in the procurement cycle and survey current research and development programs.
- Science and technology should now include coverage of those promising technologies that could affect the service's force structure in the 3-5 year horizon.

9.2 Course Development Methodology.

The educational modules envisioned for this education reform are anticipated to take the form of a complete short-course package that can be easily integrated into an existing PME course. The breadth and depth of each course will be tailored to the experience level of the officer students. Junior officers at the branch, warfare, and specialty schools will received instruction with increased depth and decreased breadth while senior officers at Senior Service Colleges will receive instruction with increased breadth and decreased depth. This educational methodology matches the transition from pedagogical to andragogical learning theory. Pedagogical learning theory assumes the student has little useful experience and gives the full responsibility for learning decisions to the teacher. In contrast, andragogical learning theory is focused more on adult education and takes into account the student's experience and natural desire and motivation to learn. While some would argue that in andragogical-based courses the teacher's role transitions to that of a facilitator, andragogical-

based science and technology courses require foundational material and therefore the need for a highly skilled teacher remains. Furthermore a resident component of these educational short-courses is important. There are several compelling reasons to include a resident component in science and technology education, one related to the discipline subjects and others that involve educational advantages. First, scientific disciplines require a certain amount of closely guided instruction to understand the fundamentals of the subject. Analogous to teaching a foreign language, there is a certain, minimum vocabulary that must be mastered prior to any self-directed continuation. Additionally, a resident component to an educational program provides an immersion experience in which the student can focus on the material, develop a close relationship with the faculty who are the subject matter experts, and allow the student to develop relationships with other students, which supports the exchange of ideas and reinforces the material. Within a distance-learning framework, these can be achieved by periodically bringing students to a central or regional location for short periods of residency.

In order to consistently develop accurate educational short-course-style modules, a process was developed by which all modules can be developed. The process begins by first identifying current and near-term military systems. Here, the term military system is deliberately used in contrast to weapon systems and include sensing systems, communications systems, computing systems as well as weapon systems at every organizational level. From this there are two components that must be developed. First, the military systems must be analyzed to determine the underlying science that enables the system from which the science content of the module will be derived. The second component requires an understanding of the doctrine and the employment of the system.

Individual vignettes or practical exercises will be developed based on this doctrine. These two components are then integrated to complete the educational module development. This process is shown graphically in Figure 9.1.

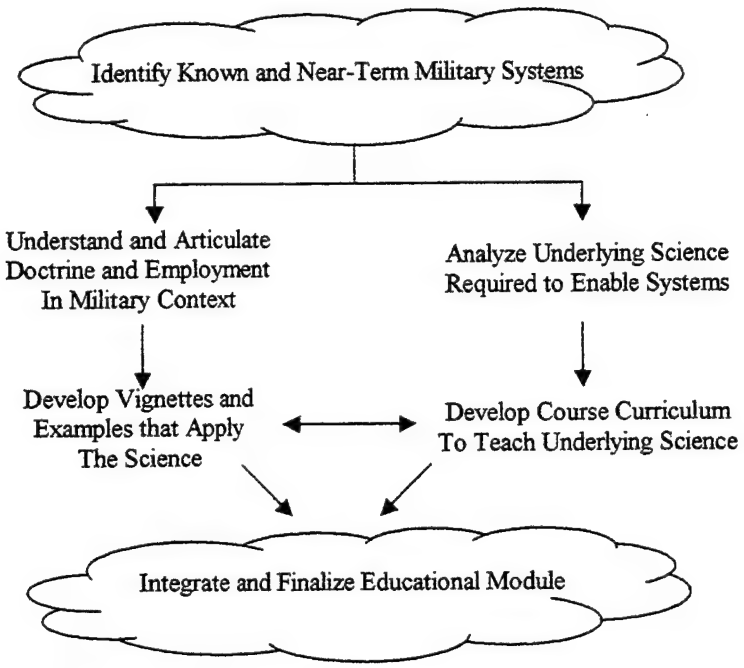

Figure 9.1. Course Development Methodology.

9.3 Proponency for Educational Reform.

The final piece of this educational puzzle that warrants consideration deals with responsibility for officer educational reform. Who establishes the requirements for technical competency, who defines the educational objectives, who develops the specific educational curricula, and who provides oversight and quality control are all questions that must be addressed to conclude this quest for increased officer technical competency.

Since the technical competencies identified in this analysis represent those cross-cutting competencies required of all officers regardless of service, grade, branch, or warfare

specialty, the logical proponent for this educational transformation is the Joint Staff. The recent changes to CJCSI 1800.01A that include increased technical focus in the learning areas reinforce this assertion. The mechanisms for defining the educational objectives and providing oversight already exist within the context of CJCSI 1800.01A. This approach also contains provisions for quality oversight, policy development, and curriculum coordination for traditional PME that could be directly applied to officer scientific and technical education. The remaining question involves who develops the educational curricula.

One approach is to provide broad, general guidance and require the individual PME institutions to develop the technical curricula. While this might be appropriate and even desirable at the senior-level PME institutions, it is not applicable at the other institutions. Because the proposed curricula at the senior-level PME institutions includes subjects related to technological innovation and the relationship to strategy, doctrine, and force planning, understanding technologically-enabled RMAs, and enabling change within large complex organizations, the faculty at these institutions are already experts at developing courses that cover these topics. Additional overview coverage of service-specific research and development organizations and the current state of scientific progress can be accomplished through integration of appropriate guest speakers. At all other lower-levels of PME, however, arguably the local institutions do not presently have the resident expertise to develop the appropriate technical curricula. To analyze the underlying science that enables a specific military system requires expertise in a science or engineering discipline. To develop the course curriculum to teach the underlying science requires expertise in the teaching profession, preferably with a focus on math, science, or engineering disciplines. These two mutually supporting tasks suggest that the more technical courses to be provided at the basic,

advanced, and intermediate-level PME institutions be developed by professional teaching faculty from academia or service academies or institutions. Understanding and articulating the doctrine and employment requires a military member from within the service. The integration of these two threads will then produce a course with the appropriate level of science and technology education at the appropriate level of application.

A methodology that holds promise is currently being developed within the Army.[129] Here representatives from the Army Research Office, the extramural research component of the Army, the United States Military Academy, the Army's Service Academy, the National Defense University, and a group of science and engineering faculty from several civilian academic institutions formed a consortium or institute to apply this course development methodology and develop several prototype science and technology courses. The intent is to then provide these short-course modules and an appropriate central or regional short-course for the responsible PME instructors. Arguably, much of the underlying science in use in current military systems is common between the services so this concept of a consortium or institute could be expanded under Joint Staff oversight with each service providing doctrinal and employment expertise to develop vignettes and practical applications relevant to the service PME.

Chapter 10. Recommendations and Reflections on Further Research.

The new security environment facing the U. S. Armed Forces that spans the full-spectrum of military conflict together with the military's relentless quest for high technology solutions to challenges in modern warfare requires new leader skills. Among these are multidimensional cognitive skills, new technical-tactical skills, and an increased awareness of the science that enables advanced technology weapon systems and shapes the modern battlefield. Today there exists a new relationship between the officer corps and technology. As a result, the current officer education system needs to be reformed to incorporate more of the underlying science that enables advanced technological systems and shapes the modern military landscape. This research represents a journey beginning with a survey of applicable teaching and learning theories and taxonomies and ending with a prototype educational framework that increases officer technical competency by reforming the existing officer PME system through the introduction of technical short-courses. At the outset, the historical landscape of warfare was surveyed to identify corollaries that might be applicable to the modern environment. Along this journey, education and training, pedagogy and andragogy, and issues related to teaching science and technology subjects were all visited. A subsequent stop was made to develop the core technical competencies required for all officers in the 21st Century. A prolonged sojourn was made to each of the Service's PME systems to determine the extent of science and technology coverage in the present curricula. The analysis conducted during this phase of the journey included Joint Staff policy relating to technical learning objectives and the proportion of officers attending each of the PME institutions.

The resulting prototype educational framework prescribes educational courses in core technical competencies that contain material at the appropriate technical breadth and depth for specific officer grade and experience that are taught in a periodic and progressive nature within the existing officer PME system. The Joint Staff serves as the proponent for this educational reform providing policy guidance and oversight of the program.

10.1 Recommendations.

The results of this research demonstrate the need for officer education reform that incorporates additional science and technology education to produce officers with increased technical competency that can be effective leaders in the 21st Century. There are several overarching recommendations resulting from this research. First, the Joint Staff should serve as the proponent for this educational reform, providing policy development, quality oversight, and curriculum coordination. Next, the core technical competencies identified in Chapter 3 of this research report should serve as a basis for education reform within the officer PME institutions. The concept of a Joint Institute should be further investigated for feasibility. Members of the Joint Institute include at a minimum military members from each of the Services, science and engineering faculty from academia, members of each of the Service's research and development organizations, representatives from the Service's PME institutions, and Joint Staff representation. The Institute would serve in an oversight and advisory capacity, providing guidance on the scientific content of the courses, oversight of the course development, and periodic review of the curricula content. Since the core technical competencies require periodic review to remain current, the Joint Institute would

also serve this role. Finally, the courses included within each PME institution should be developed within the framework identified in Chapter 9 to ensure the appropriate technical content, suitable breadth and depth, and levels of learning achievement are attained.

10.2 Reflections on Further Research.

In addition to the research results already discussed, an additional element of this research deserves further investigation. This final element concerns the relationship between system complexity and higher-level cognitive decision-making skills.

The argument has been made that increased technological complexity in modern military systems requires additional understanding of the underlying science that enables these systems. In addition, an abundance of available information and changes in organizational structure resulting from technological innovation suggest that more complex decision making skills are necessary. Three factors have been identified that contribute to this increased decision complexity: flattening of organizational hierarchy requiring increased span of control, increased automation and a corresponding reduction in personnel requiring increased breadth of knowledge, and a reduction in the total amount of information converted to knowledge requiring an increased cognitive workload. Implications of network centric warfare beyond massive connectivity and real-time information exchange to all organizational elements suggest that some echelons of command can be eliminated. In this case, the span of control of senior leaders necessarily increases and consequently the leader's ability to directly supervise subordinates decreases. This organizational change effectively increases the span of control of leaders. Additionally, network centric warfare enables

ubiquitous communication networks that interconnect sensors, command posts, weapons delivery systems, and logistics units across the battlespace. In this environment, the data presented on command center displays is more likely to be an amalgamation of both raw information and processed knowledge. In contrast previous visualization approaches in which a commander's staff processed all information prior to displaying symbols that represented knowledge, technology now allows unprocessed sensor data to be displayed in near-real time on a common operating picture. As a result, the commander must now not only focus on decision-making skills but must also perform some of the analysis processing previously performed by the staff. This new information environment increases the cognitive workload of the commander. Finally, an increased focus on autonomous systems for reasons ranging from reducing potential casualties to the number of crew on a platform requires an increased breadth of knowledge for those in positions of authority.

Additionally, the way in which humans interact with media bares consideration. In 1964, Marshall McLuhan published the book *Understanding Media: The Extensions of Man*[130]that categorized media as cool and hot. A hot medium like radio or the movie extends a single human sense to high definition and requires low audience participation and completion. In contrast, a cool medium like telephone or television is low definition and therefore requires a high level of participation or completion by the audience. The type of media therefore determines the level of participation by the audience and consequently the level of engagement by the viewer. The implication of McLuhan's concepts to the modern military command center, which is replete with visual displays, also warrants further investigation in relation to cognitive skills.

These cognitive challenges to managing and leading technologically complex organizations are something that deserves further investigation. While the increased focus on education and technical competency of the officer corps advocated in this research report can help improve higher-level cognitive skills, additional methods to deliberately develop these skills and prepare officers to deal with these complexities must be pursued.

End Notes

[1] Martin van Creveld, The Training of Officers, (The Free Press, 1990), p. 14.
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